the Petroleum Engineer

An International Monthly

DECEMBER • 1949

VOLUME XXI NUMBER 13

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The PETROLEUM ENGINEER Publishing Company

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The Petroleum Engineer, published monthly, August through June, semi-monthly in July, by The Petroleum Engineer Publishing Company, Seventh Floor, Irwin-Keasler Building, Dallas, Texas. Subscription rate to the petroleum industry, United States and Foreign, $3.00 per year, $5.00 for two years; 25c a copy or back copies over 3 months old, 50 cents. Entered as second-class mail matter May 1, 1932 at the post office in Dallas, Texas, under the Act of March 3, 1879.

THIRD WORLD PETROLEUM CONGRESS

Preliminary details have just been announced of the organization of the Third World Congress, to be held in The Hague, Holland, from May 28 to June 6, 1951. This is expected to be the most important post-war gathering of the world's oil experts.

The first World Petroleum Congress was held in London in 1934; the second in Paris in 1937. The initiative for these congresses was taken by a permanent council composed of delegates from several countries. The present permanent council will be composed of delegates from the U. S. A., Great Britain, France, Canada, Venezuela. Belgium, and The Netherlands. The chairman is Colonel Louis Pineau of Paris, the secretary, Mr. D. A. Hough of London.

In May, 1949, this Council decided to hold the Third World Petroleum Congress. Its organization was first offered to representatives of the U. S. A., who declined, however, in view of the fact that the U. S. A. is already entertaining many congresses in this field. The Council thereupon resolved that this Third Congress should take place in The Netherlands.

The Petroleum Section of The Netherlands Royal Institute of Engineers in The Hague was invited to organize the Congress. They accepted this invitation after obtaining the support to The Netherlands oil industry. As a consequence, the organizing committee of the Third World Petroleum Congress was formed, with G. A. Tuyl Schuitemaker as chairman, J. A. Beukers as treasurer, and J. W. Zwartsenberg (30, Carel van Bylandtlaan, The Hague) as secretary.

The Congress will be held in The Hague-Scheveningen, and members attending will be accommodated at the main hotels there. The sessions of the various sections of the Congress will be held in three halls of the Kurhaus Hotel.

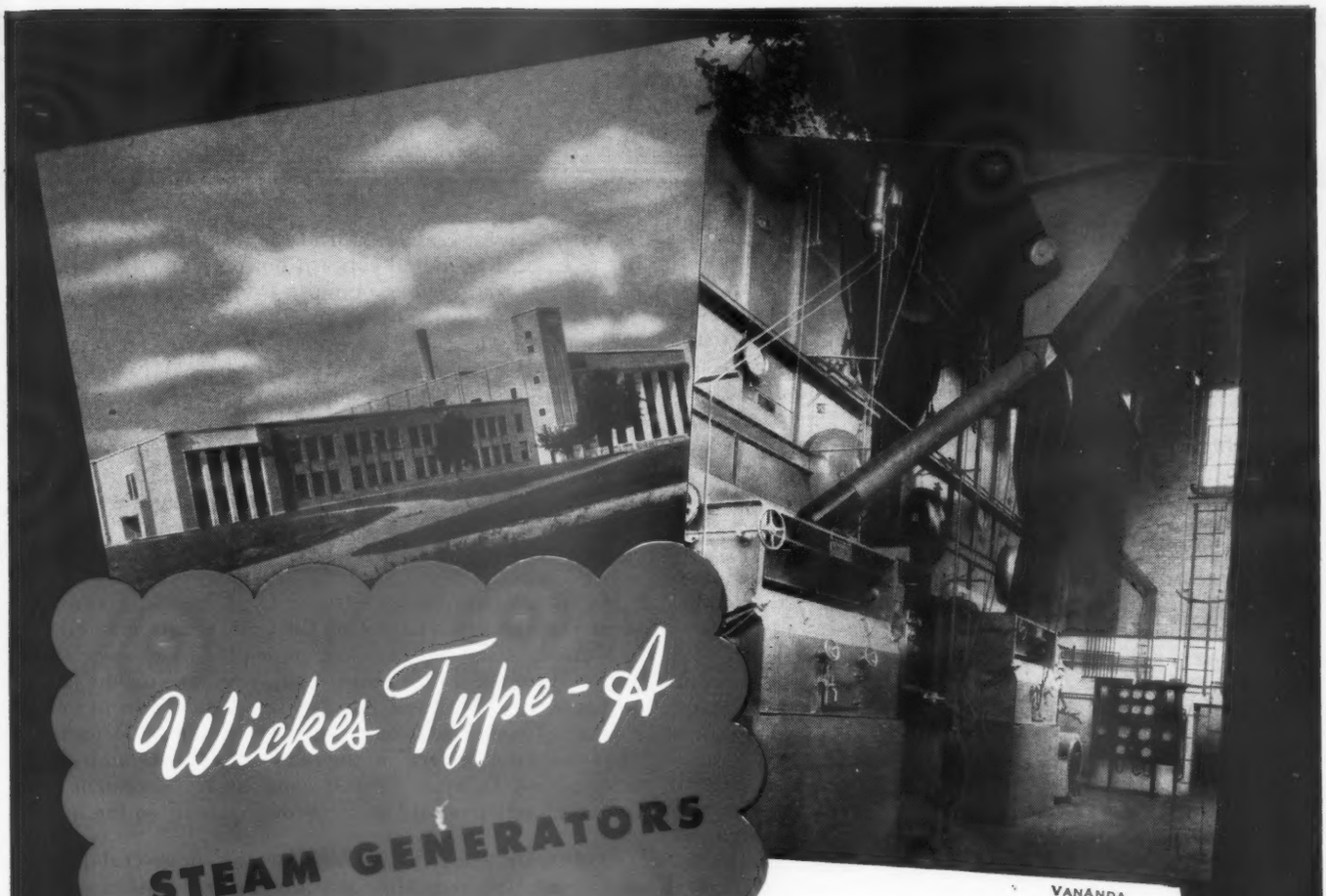
National committees are being formed in each country to invite, collect, and screen reports from their countries. These reports, each accompanied by a summary, will finally be forwarded to the organizing committee in The Netherlands. The official languages at the Congress will be English and French and all reports have to be submitted in one of these languages or in both. It is intended to send preprints of the reports to members of the Congress before March 1, 1951.

The purpose of the Congress will be to focus attention on the present position of science and technique in the petroleum industry. There will be ten master sections at the Congress:

1. Geology, Geophysics, Geochemistry;
2. Drilling and Oil Production;
3. Physical Technology;
4. Oil processes involving chemical conversions;
5. Production of chemicals from petroleum, their properties and applications;
6. Measurement and Control, Testing, Chemical Analysis;
7. Utilization of oil products;
8. Construction of equipment, materials, corrosion;
9. Transport, storage, distribution;
10. Economics, statistics, documentation.

These sections will discuss papers submitted by petroleum experts of international standing. The general reporter of a given section will read abstracts from the papers under consideration, and suggest topics for discussion. These discussions and the conclusions reached will also be published in the Proceedings of the Congress.

Those taking part in the Congress will find an opportunity of studying The Netherlands, not only by excursions to its petroleum and other industries, but also by tourist trips to typical Dutch towns and rural districts. A ladies' committee will arrange for the reception and entertainment of lady visitors during their stay in The Netherlands. A pamphlet, giving full particulars, will be available early in 1950.



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Scanning WASHINGTON'S OIL HORIZON

By **MILBURN PETTY**

WASHINGTON—Interior Secretary Chapman's oil policies will be more like those of Ickes than of Krug except that, being from the Rocky Mountains, he will be more liberal on public lands leasing than either of his predecessors.

After Secretary Krug's "resignation" was announced, one of Chapman's first moves was to call off the Denver hearings on leasing rule changes proposed by Assistant Secretary Davidson. Chapman had never agreed with Davidson's idea (backed by Krug) that bids be required on all public lands where a competitive interest was shown.

Key to Chapman's policies lies in the fact that he was an original member of the New Deal, having been Secretary Ickes' first appointee in 1933. He has maintained friendly relations with Ickes ever since. Chapman was—and still is—a new dealer. Remember that in the months ahead.

Chapman has "many ideas about petroleum" that he will now have a chance to put into practice so long as he stays within the framework of President Truman's "fair deal."

▸ **Imports.** Hearings by Congressman Keogh's oil import committee are supplying the IPAA with plenty of ammunition for the coming fight to limit the entry of foreign oil into the United States. Forecasts by the importers themselves indicate that imports are currently around 700,000 B/D and may climb another hundred thousand barrels daily by spring.

The hearings have disclosed that two of the importing companies, Indiana Standard and Cities Service, believe that imports are now "supplanting" domestic production (which other importers deny). The Indiana company believes that the industry can handle the situation. Cities Service hopes that the National Petroleum Council will come up with a solution to the import problem but is ready to consider "as a last resort" legislation to fix a ratio for imports —if the NPC doesn't come through.

▸ **ECA.** ECA's oil division can be given an "E" for effort in trying to cut back Europe's ambitious refinery expansion programs. But that is all. Extent of ECA's failure to halt these expansion plans (which ECA has said are inflated by overly-generous estimates of anticipated demand) is just now becoming apparent.

The Marshall Plan countries, at a recent meeting in Paris, refused to make more than a token cutback in their refinery programs.

Now, ECA officials here disclosed, Europe is already within sight of its 1952 refinery goal of 62,400,000 tons annual capacity (1,250,000 B/D). Projects have been started—with or without ECA's approval—totaling 52 million tons. ECA is now considering projects in the bracket between 52 and 62 million tons. (At the end of 1948, Europe's refinery capacity totaled 24,000,000 tons.)

▸ **Exchanges.** Federal Trade Commission plans an investigation of inter-company exchanges of products and crude, looking into complaints that a nationwide system of exchanges exists among a "selected few" refiners and that some small refiners find they cannot negotiate exchanges of crude with some of the major companies.

▸ **Gas.** Holley Poe's prediction at the Chicago API meeting that natural gas will soon be available to the Northeastern States, which have about half of the oil burner installations in the U. S., has caused concern not only among marketers but refiners who are beginning to wonder what they will be doing with the fuel oil they must make in order to supply gasoline demand. So, it has been suggested that the National Petroleum Council make a study of the natural gas situation, particularly whether important industrial centers may be becoming overly dependent on gas from the standpoint of reserves and national security. Meanwhile, Texas Eastern Transmission Company, of which Holley Poe was the first president, has applied for permission to extend the Big Inch pipe lines to supply New England utilities with 200,000,000 cu ft of natural gas daily by 1951.

▸ **Mexico.** Congressman Crosser (D, Ohio) has seen President Truman again regarding the U. S. granting an oil loan to Mexico, which has been recommended by Crosser's committee. Truman didn't require any needling on the matter (because he long ago gave his personal endorsement to such a loan). Crosser felt, however, that the State Department was "dragging its feet" in the loan negotiations and wanted to so advise Truman. Crosser came away "confident" that favorable action would be forthcoming soon on the loan.

▸ **Prices.** Oil prices are getting attention in several quarters on Capitol Hill, indicating that the coming session may see several congressional committees active on this subject. which is considered a good vote-getter for an election year. Congressman Mansfield (D, Montana), a member of the House committee investigating oil imports, wants to know why gasoline sells for 34 cents in his state. Senator Gillette (D, Iowa), author of oil divorcement bills, has listed gasoline as one of the matters that his agriculture subcommittee will study in checking prices on what the farmer sells and buys. Senator Maybank (D, South Carolina), chairman of the subcommittee investigating gasoline prices, has turned over to Attorney General McGrath the data so far assembled "with the thought that it may be of some interest to you in connection with Civil Action No. 8524 (the API-Mother Hubbard oil antitrust suit pending here since 1940)."

▸ **Tidelands.** Convinced that national security requires that offshore oil resources be developed and ready for use in an emergency, Chairman O'Mahoney of the Senate Interior Committee may soon take the lead in working out some practical compromise of the federal-state controversy over tidelands oil control. O'Mahoney will have his committee explore all the angles involved but, down the road, he knows that something must be done. So, spade work should be started. O'Mahoney may go along with a royalty split with the states but he leans toward federal control of leasing. Meanwhile, Texas Attorney General Daniel has sent word to O'Mahoney: Don't get the idea that Texas is backing down even though the oil industry is willing to compromise on a federal leasing bill.

▸ **Pipe Lines.** Enforcement of the statutory requirement that the pipe lines (oil or gas) crossing public lands must perform common carrier service has moved a step nearer a final decision with Examiner Baron of the Federal Power Commission instructing Montana-Dakota Utilities to transport 500,000 cu ft of gas daily from one of Mondakota Gas Company's wells in Montana to an industrial consumer in South Dakota.

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Highlights in Oildom

Atomic Energy vs Petroleum. Atomic energy will never be a serious competitor to the petroleum business but the research now in progress in the nuclear field will aid immeasurably in hastening the day when the sun's rays will be converted into saleable energy, L. L. Davis, manager of Continental Oil Company's development and research department believes.

It is a long way off but it is entirely possible that automobiles, trains, and planes, if they are still the principal modes of transportation in the distant future, will be propelled by energy produced from the sun, Davis said.

"There is no likelihood of our running out of oil in the foreseeable future," he added, "We have four sources of oil reserves which will last from 200 to 2000 years. They are natural gas, coal, oil and tar sands, and oil shale."

Government Regulations Conflict. Unless Congress clarifies the philosophies of the Sherman Anti-Trust Act and the Patman Act, businessmen face the prospect of being caught between conflicting regulations governing fair-trade activities. William Simon, prominent lawyer and former counsel for the Capehart Committee of the 80th Congress, sounded this warning in an address before the division of marketing at the American Petroleum Institute's 29th annual meeting in the Stevens Hotel.

Urging enactment of a bill sponsored by Senator O'Mahoney to clarify application of anti-trust and fair-trade laws, Simon said: "Rigid prices in any industry are generally used to prove violations of the Sherman Act, which makes all price fixing illegal. But, on the other hand, flexibility of price is almost certain to result in a violation of the price-discrimination provisions of the Patman Amendment to the Clayton Act."

U. S. Urged to Begin Oil Stock Pile. Now is the time for the U. S. to begin its stock pile of oil, The Pennsylvania Grade Crude Oil Association has declared. The Association told the armed services petroleum board that a slumping market in lubricants has resulted in oil well abandonments and a consequent loss of unrecoverable reserves.

The military board stressed the fact that more than two-thirds of current production comes from what are called secondary recovery operations. As a result, it declared, the extent to which producers can bring about a balance of crude oil supply and demand without waste of resources is limited. The Association also added that exports, which consumed 15 per cent of the Pennsylvania grade lubricants before the war, now are down to "a trickle" because of foreign buying policies. "Consequently, the Pennsylvania grade industry is confronted with a critical over-availability of lubricating oils and insufficient markets."

Annual Report Is Good Promotion Medium. Frank W. Abrams, chairman of the board, Standard Oil Company (New Jersey) believes that one of the main reasons responsibility for production is being shifted in many parts of the world from private management to government, is that people do not feel that they have a voice or influence in business. Abrams, in accepting the golden "Oscar of Industry" for the best 1948 annual report of all U. S. Industry, pointed out that the Jersey Standard annual report is a fundamental medium of communication, not only for stockholders but for employees and the consuming public in general.

Mexico's Imports May Exceed Exports. Oil experts are predicting that Mexico will spend more for imported petroleum products this year than she will receive from crude oil and derivatives in export trade, despite the fact that she is increasing her oil production. Estimates indicate that petroleum exports for the year will bring in approximately $26,000,000 but that imports will reach about $28,000,000. During the first quarter of the year, exports were up nearly 40 per cent compared to the same period last year.

Natural Gas Invades Fuel Market. The rapid growth of the natural gas industry and its plans for future development have been described as the "greatest single invasion of any fuel market that has ever been conducted at any one time in all history." In an analysis of the effect that natural-gas operations are going to have on kerosine and fuel-oil markets, E. Holley Poe, of New York, stated at the annual API meeting that gas will have an increasing impact as transmission lines are extended.

Addressing the division of marketing, he said: "This is no bad dream that will pass over, come tomorrow's dawn. It is real competition; it will grow instead of diminish; and it will certainly have a profound effect on your own business."

Peru Offers Oil Concessions. Faced with the prospect of having to import oil in the next few years, Peru is making an all-out bid for her place in the oil picture. Recent legislation has thrown open Peru's oil deposits to development by foreign capital, and has drawn up a four-point plan.

First draft of the new decree-law reads: The entire country, coast, mountains, jungle east of the Andes, is open to exploration. In royalties, the government will collect 12½ per cent of the oil produced along the coast, 6 per cent of that taken from the mountains, and 3 per cent on that from the jungle. There will be no tax on oil exported from Peru. The companies will be permitted to keep all foreign exchange derived from exports. Unlimited acreage is allowed for exploration, but each company must turn back 50 per cent of the explored land when it enters the development stage. This new attitude developed by Peru is quite different from the war years when oil men were literally begging for concessions.

Warm Winter Brings Surplus Oil. An ironical note is being sounded in the oil industry—for the past two years, both mild winters, there has been an overabundance of oil; two years ago the supply was short, and the weather was cold.

Texas, although confident a month ago it had hurdled the supply-demand problem, ordered a 218,357-bbl daily cutback in December crude oil production allowables. The reason—the supply far exceeded the demand, and it's all the fault of a too warm autumn.

ECA Makes Oil Grant to England. A grant of $54,726,000 to Great Britain, of which $32,500,000 is to be used for the purchase of crude oil and petroleum in the United States, Latin America, and the Middle East has been made by the Economic Co-operation Administration. This grant was made in spite of the fact that Great Britain has signed an agreement with Argentina to supply the latter country with its oil requirements for the next five years.

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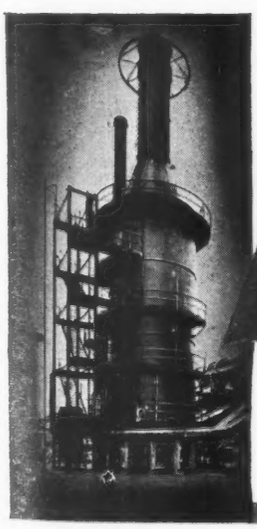

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National Petroleum Situation

DEMAND SUB-NORMAL. Mild temperatures in the Northeast and Midwest, which have been 20 per cent above normal this season, have seriously disrupted the oil supply program. Fuel oil demand through October was 6 per cent below last year, whereas demand in 1948 vs 1947 increased 3½ per cent, and the 1947 vs 1946 increase was 13 per cent. Forecasts, based upon normal seasonal requirements have been knocked into a cocked hat, and refiners and distributors of fuel oils are seriously overstocked. Refinery runs to stills are being curtailed and crude production schedules are being reduced.

SUPPLY CURTAILMENT. Mid-November reports indicate drastic efforts to curtail supplies. Refiners cut runs to stills by 187,000 bbl daily; distillate fuel output was reduced 50,000 bbl daily; Texas Railroad Commission announced cut in December allowable of 218,357 bbl daily in response to widespread alarm over top-heavy supply situation. Stocks of all oils were increased nearly 6,000,000 bbl in October, and mid-November estimates indicated a further gain of at least 2,000,000 bbl. Fuel oil stocks on October 31 were 8,000,000 bbl above the September 30 level. Reduced runs to refinery stills also reversed the downward trend in crude stocks.

IMPORTS UP 22.6 PER CENT. Imports of all oil through October aggregated about 184,401,000 bbl, against 150,234,000 bbl in the same period of last year, an increase of 22.6 per cent. Crude oil imports this year amounted to 127,575,000 bbl, against 101,623,000 bbl last year. Refined oil imports this year were 56,326,000 bbl, against 48,611,000 bbl last year. Domestic supply of all oils this year has thus far been reduced by about 134,699,000 bbl, or 8 per cent below the same period of last year.

DRILLING EASES OFF. While drilling operations have been continued at a relatively high rate, there has been an easing tendency in the closing months of this year. It is now indicated that total well completions in 1949 will approximate 38,600, compared with 38,900 completions in 1948. It had been anticipated earlier in the year that 1949 drilling operations would top all previous records. Highly favorable, however, is the fact that this year's wildcat completions will be about 6700, against 6300 in 1948. New operations in October were about 5 per cent under last year.

Comparative Statistics, October, 1949

*All figures are computed on a Bureau of Mines' Basis**

	October 1949(P)	Sept. 1949(P)	October 1948	This Year to date	Last Year to date	Percent change
Total supply, all oils	190,111	179,061	203,862	1,838,858	1,939,390	— 5
Daily average	6,132	5,968	6,576	6,048	6,359	
Total demand‡, all oils	184,161	177 801	184,226	1,813,651	1,852,670	— 2
Daily average	5,941	5,926	5,943	5,966	6,074	
Change in stocks	+5,950	+1,260	+19,636	+25,207	+86,720	
Crude supply*	171,190	160,650	187,153	1,657,369	1,771,334	— 6
Daily average	5,522	5,355	6,037	5,451	5,807	
Crude demand‡	177,240	167,335	180,483	1,666.146	1,758,016	— 6
Daily average	5,717	5,577	5,822	5,480	5,764	
Crude stocks	247,850	253,900	243,972	247,850	243,972	+ 2
Days supply	43	45	42	43	42	
Natural gasoline production	12,460	12,000	12,805	124,553	119,143	+ 4
Daily average	402	400	413	409	390	
Motor fuel production	83,060	78,650	79,476	796,758	760,178	+ 5
Daily average	2,680	2,621	2,564	2,621	2,492	
Gasoline yield per cent	42.1	42.7	40.7	43.4	40.1	3.8
Motor fuel demand‡	82,755	80,255	78,069	793,823	757,709	+ 5
Daily average	2,669	2,675	2,519	2,611	2,484	
Motor Fuel Stocks	103,815	103,510	90,142	103,815	90,142	+14
Days supply	38	37	35	38	35	
Fuel oil production	65,650	61,980	72,453	628,693	701,481	—10
Daily average	2,118	2,066	2,337	2,068	2,300	
Fuel oil demand‡	64,690	61,080	67,240	667,844	712,313	— 6
Daily average	2,087	2,036	2,170	2,197	2,335	
Fuel oil stocks	158,600	150,680	155,283	158,600	155,283	+ 2
Days supply	76	74	71	76	71	
Refinery still runs	167,590	160,800	173,429	1,616,024	1,683,169	— 4
Daily average	5,406	5,360	5,594	5,315	5,518	
Stocks, all oils	630,950	625,000	587,520	630,950	587,520	+ 9
Days supply	110	112	101	110	101	

Current Crude Oil Prices

U. S. Average	$2.55	Louisiana	$2.62
Texas	2.61	Arkansas	2.43
California	2.42	New Mexico	2.40
Oklahoma	2.63	Mississippi	2.26
Kansas	2.62	Illinois	2.76
		Other states	2.60

Basic crude prices:

Oklahoma-Kansas (36 gr.)	$2.57
Texas Gulf Coast (36 gr.)	2.80
East Texas	2.65
West Texas (36 gr.)	2.44
California Signal Hill (26 gr.)	2.31
Pennsylvania, Bradford	3.40

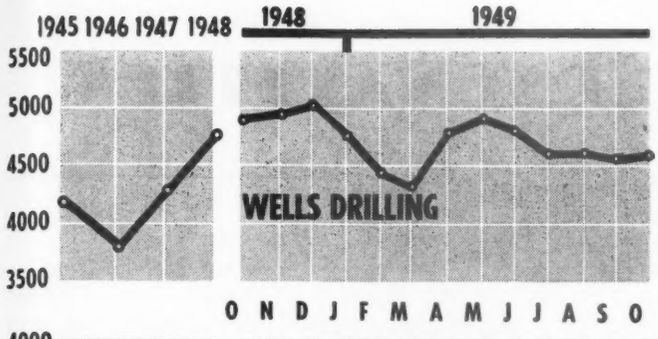
Drilling and Production Statistics

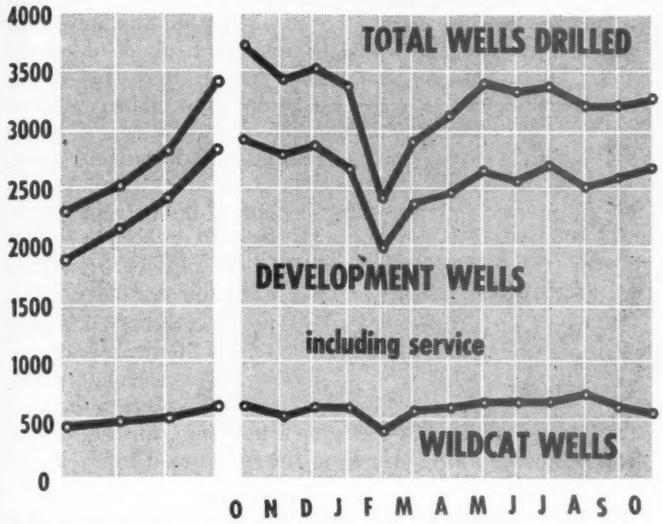
	October 1949(P)	Sept. 1949(P)	October 1948	This Year to date	Last Year to date	Percent change
Wells drilling	4,615	4,565	4,850	4,615	4,850	— 5
Total wells drilled	3,315	3,298	3,610	32,017	31,887	+ 1
Development wells	2,640	2,596	2,813	25,357	31,887	+ 1
Oil	1,747	1,730	1,922	17,065	17,287	— 1
Gas	269	249	260	2,291	2,125	+ 8
Dry	624	617	631	5,991	5,558	+ 8
Per cent dry	23.6	23.8	22.4	23.7	22.3	+ 1.4
Service wells	107	91	170	1,005	1,725	—42
Wildcat wells	568	611	627	5,655	5,192	+ 9
Oil	89	85	86	882	793	+11
Gas	10	23	21	153	215	—29
Dry	469	503	520	4,889	4,184	+17
Per cent dry	82.7	82.6	82.9	86.5	80.6	+ 5.9

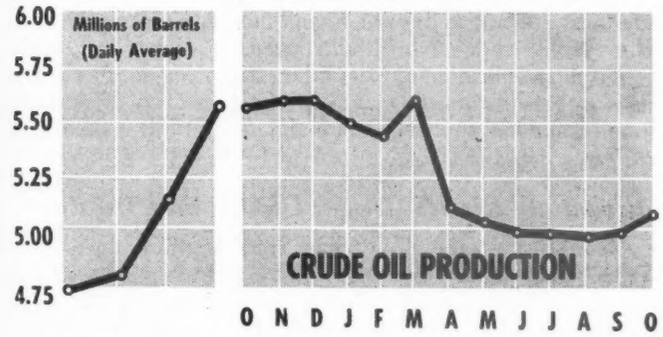
By State

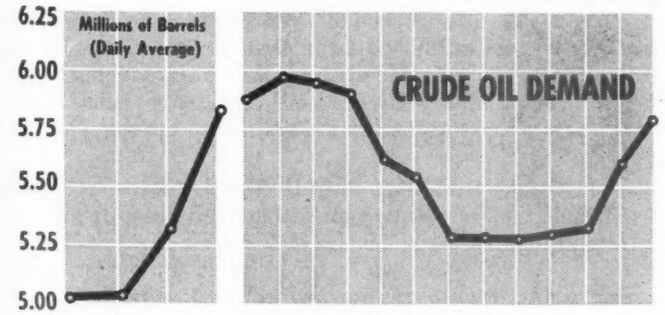
Wells drilled (excl service)	3,208	3,207	3,440	31,012	30,162	+ 3
Arkansas	32	30	33	277	260	+ 6
California	205	222	239	2,126	2,373	—10
Illinois	222	257	269	2,124	2,008	+ 6
Kansas	309	273	309	2,704	2,580	+11
Louisiana	210	247	222	1,960	1,919	+ 2
Mississippi	27	25	38	284	343	—17
New Mexico	46	36	50	406	496	—18
Oklahoma	369	334	400	3,486	3,446	+ 1
Texas	1,108	1,117	1,105	11,472	9,944	+15
Other states	680	666	775	6,173	6,792	— 9
Wildcats drilled	568	611	627	5,655	5,192	+ 9
Arkansas	6	9	9	58	83	—30
California	44	38	58	421	394	+ 7
Illinois	65	55	53	426	364	+17
Kansas	40	55	63	430	432	0
Louisiana	22	27	31	263	249	+ 6
Mississippi	11	9	12	92	88	+ 5
New Mexico	8	8	7	69	51	+35
Oklahoma	65	54	73	659	685	— 4
Texas	218	255	225	2,431	2,098	+16
Other states	89	101	96	806	748	+ 8
Daily crude production	5,064	4,921	5,632	5,032	5,474	— 8
Arkansas	71	78	88	80	86	— 7
California	876	890	938	919	924	0
Illinois	180	176	182	176	176	0
Kansas	274	60	309	277	301	— 8
Louisiana	560	512	501	519	490	+ 6
Mississippi	100	102	131	105	124	—15
New Mexico	127	118	135	130	130	0
Oklahoma	427	397	432	415	416	0
Texas	2,050	1,983	2,529	2,029	2,452	—17
Wyoming	128	129	154	127	147	—13
Other states	271	275	233	255	228	+12

*Unless otherwise stated all figures represent thousands of barrels. (P)—Premliinary. *Includes domestic production and imports.
‡Total demand, including exports. Note—May and cumulative data revised to reflect changes in reporting by U. S. Bureau of Mines.
Preliminary estimates based upon data supplied by American Petroleum Institute, U. S. Bureau of Mines, State Agencies, and other official sources.

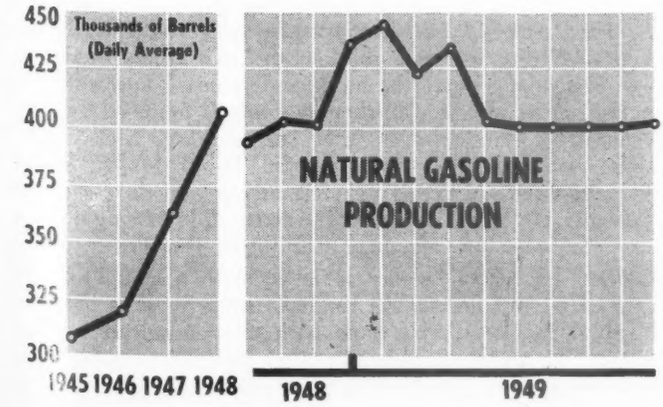


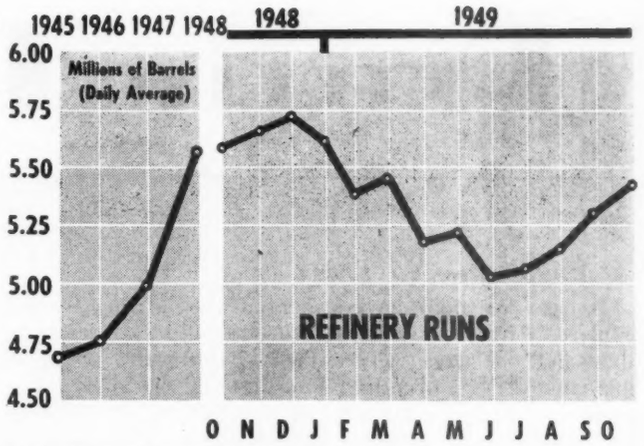


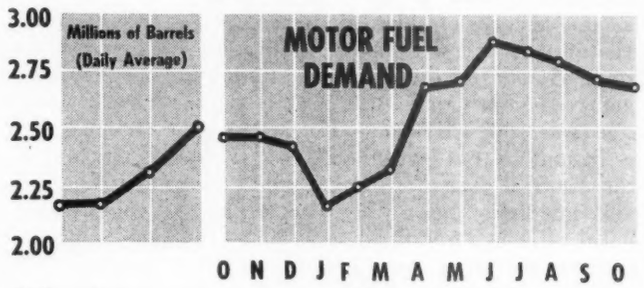


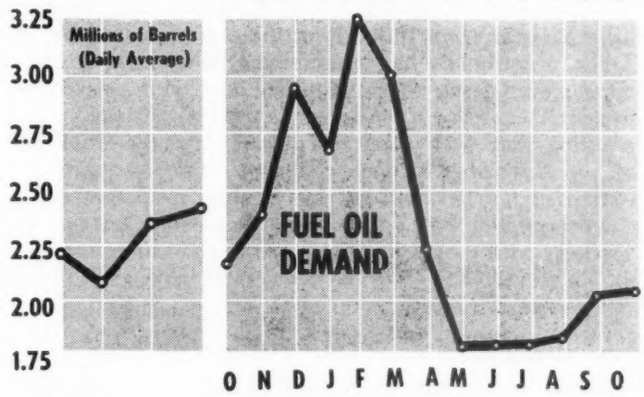


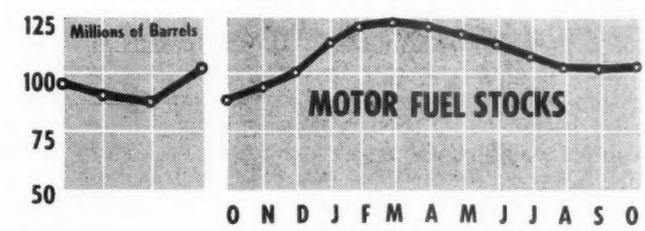
September and October figures are estimates.

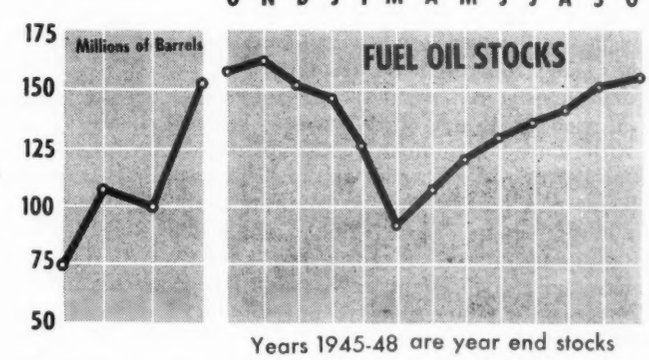




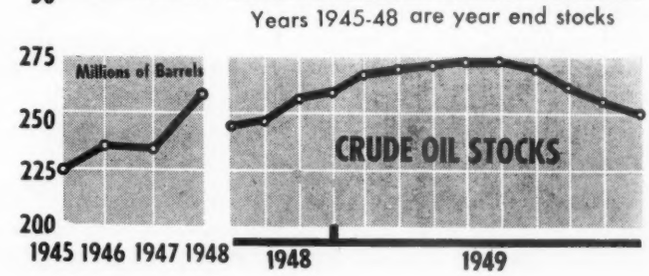








Years 1945-48 are year end stocks



PETROLIC PERSONALITIES

DICK SNEDDON

A Magician—No Less

In case you might have wondered whence came the beautiful red carnations with which the throbbing breasts of a thousand delegates were colorfully decorated at the late lamented API convention, be it known that they were a symbol of Franklin friendliness and hospitality. Gene Harper, the estimable prexy of Franklin Supply Company, and a capable corps of aides, pinned a posy on the lapel of every visitor who called at company headquarters in the Blackstone Hotel, and the extent of the gesture may be roughly gathered from the fact that in due course the entire convention was suffused with a warm red glow. Indeed, it was estimated by our favorite estimator that at the height of the carnival carnations were almost as plentiful as people and, goodness knows, people were plentiful. In addition to floral offerings guests were served sustenance of titivating types and in infinite variety.

Besides that, there was impromptu but nonetheless baffling entertainment throughout the entire session by Mose Tiller, a nationally known magician, who made things disappear even faster than the guests, and with a rare finesse to boot. According to one observer, the Tiller tricks were so amazing they even amazed Tiller. To top the whole thing off, on November 8, *The Petroleum Engineer* quartet, consisting of Cy Perkins and his Misfits, 1945 international champs of the Barber Shoppers, supplemented the Tiller Trickery with their admirable repertoire of tonal magic. All of which was cheered to the echo—and later, even the echo was cheered.

Crack a Fluid Cat? Hey, Wait!

Meantime, in the foyer leading to the Ivy Room, the Franklin Supply Company had set up a cute scale model of a UOP fluid cat cracker that was recently installed at Globe Refining Company's Lemont, Illinois, plant. Dan Ernest, chief engineer, was in charge of the exhibit, and was kept busier than a bebop conductor's baton explaining the how of the thing, and answering a myriad of questions, like for instance, why is it necessary to crack a fluid cat, and technical stuff like that. Anyway, we hear tell that Dan handled this educational assignment with aplomb—even eclat—and never lost a whit of his zest through four long days and four long nights of it.

Referring still to the Chicago caucus, we are further informed that G. L. "Hap" Parsons, general puchasing agent of the Pure Oil Company, easily furnished new proof of the aptness of his nickname at the big whingding. Hap never bends an elbow to pick up anything more stimulating than a bottle of pop, yet his whole life is a glad song. He has a high good humor that radiates out a long way to dispel sadness and gloom wherever they may lurk, and his influence is vastly the better that it is not stimulated. It is as natural and wholesome as a sleeping babe, and every bit as much to be admired. We tip our editorial chapeau to this prince of good fellows, whose friends have tabbed him with the moniker "Hap"—short for "Happy"—in recognition and approval of his agreeable disposition.

Can You Get Over-Retired?

Wherewith we veer off acutely to ponder the strange case of one Marshall Walton, retired. Marshall, not long ago, was oil sales engineering chief for Arthur G. McKee Company, but there came a day when he pined for freedom from the attachments and entanglements of business, and he retired—at least that's what the man said. Thereafter he hied, with his spouse, into a long admired retreat in the mountain wilds of New Mexico, where he remained for all of several hours. Then, of a sudden, under his tell-tale gray Texas sombrero, he was seen streaking out into space. Where? Canada, New York, Old Mexico—anywhere, in a hectic scramble to do important somethings for important somebodies. Today he negotiates a sale of oil lands; tomorrow a foreign government needs the benefit of his petrolic know-how; again a mining syndicate seeks help on how to exploit a discovery, or some manufacturer needs engineering advice to translate a screwball idea into a feasible actuality.

It makes little difference where or what the mission may be, he will be there. He eats lunch in a Mexican cafe and talks casually in that familiar Brazos River accent to a cow waddy as bronzed as he. For his next sit-down meal he may be found in Toots Shor's elegant emporium, hosting a New York police captain. (He was himself once a looey in the N. Y. force.)

He carries the open sesame to the places and people that are most difficult of approach, and he really makes use of it. However, as suddenly as it all started, he dashes back again to his mountain hide-out to gather steam for another sortie into the industrial wilds. Which merely proves, as we have long contended, that relaxing is the hardest thing an American ever does.

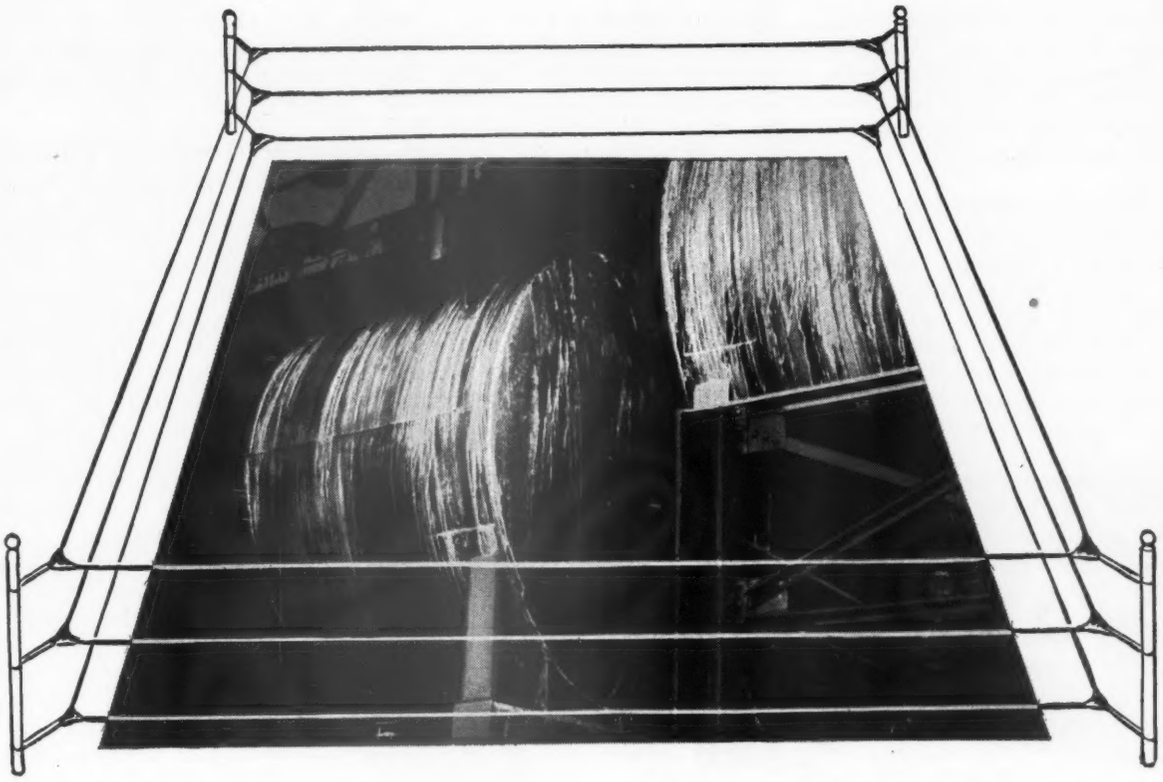
All About Divots, Dogs, Doves, and Dudley

No native of the Lone Star State is more thoroughly Texan than Dud Tower, the blond whirlwind from Los Angeles who looks after Union Oil Company's affairs in the Gulf division. Dud was actually born in the Angel City; was a baseball and basketball letter man at University of California, and graduated from that illustrious institution in 1933. He lofts a sizable divot; fishes on the slightest provocation; bets Cal will win the Rose Bowl game; and in general has more enthusiasm and elan than a high school cheer leader.

In fact, we are told that when Reese Taylor and Cy Rubel were in Houston recently consorting with Jesse Jones, the latter offered to trade his hotel for Dud Tower's youth. Dud's good lady, Genevieve, niece of L. P. St. Clair, ex prexy of Union Oil Company, heard of the offer later, and still wonders why her hubby didn't make a deal.

Incidentally, the Towers became the parents of a genuine Texan, Dudley, Jr., a short time ago. The lad already has a torso like a Roman gladiator, and it is freely predicted, will easily perpetuate the name and fame of Tower Major, in the sports arenas, rathskellers, and oil fields of the next generation. It is reported that Jim McNeill, Nick Carter, Don McMahon, and the aforesaid Tower Major, joined forces before Thanksgiving on a turkey and dove shoot at Leesville, near San Antonio. The party didn't bring down a single gobbler but came back with the limit of doves.

Nick Carter, by the way, is the rector of a school for bird dogs. His students are all English setters so they have the loveliest manners, and bark with a pronounced Etonian accent. We understand that in other hunting eras, the setter was supposed to crouch when he scented game, but nowadays



H_2SO_4 versus VMCH

VINYLITE Resin VMCH coatings on chemical and processing equipment are daily winning knock-down drag-out fights against sulphuric acid as well as other strong acids and alkalies.

Our fight ring above shows tanks used to concentrate sulphuric acid at temperatures usually around 90 to 100 deg. F. There's considerable spillage, yet, after a full year's exposure, their air-dry coating based on VINYLITE Resin VMCH is unharmed.

There's a powerful example of coating protection in the 'derail' sign, too. Photographed after seven years' protection by VINYLITE VMHH-based baking-type coating, in an extremely corrosive industrial atmosphere, it is still virtually as good as new. These are just two examples of the excellent chemical resistance of coatings based on VINYLITE Brand Resins—for tanks, vats, pipes, plate racks, and other types of chemical and processing equipment.

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he is expected to be a little more emphatic, and to stand up and point. Anyway, during their term in Carter's Canine College, Nick keeps all these bird dogs busier than bird dogs, which ought to be a good lesson to them.

Three Years in Dharhan

Bumped into big good-looking Tom McMahon a short time ago, vacationing in California after a 3 year stretch in Dharhan. Tom, drilling equipment engineer for Aramco, is a petroleum natural. His dad is Emmet McMahon, well known San Joaquin Valley oil man, and Tom was born among the derricks on the K T & O lease at Bakersfield. He graduated in petroleum engineering from U S C, and has been close to the oil business all his life. He worked school vacations with Shell, Richfield, and later with the contractors at the Pacific Naval Base at Hueneme. Following that he went to Saudi-Arabia as petroleum engineer; acted for a while as liasion man between Aramco and the E. C. Brown Drilling Company, and then acquired his present post. Tom is an observant sort of a chap and converses very ably about the land of his temporary adoption. He is a photo enthusiast and hopes to return home for his next leave with a set of color slides to illustrate the places and things he speaks of so interestingly.

Four Horses or Horseman

The Petroleum Club of Los Angeles was the scene of a determined Hibernian assault lately, when the Kelley boys—Jim and Larry—launched a frontal attack and succeeded in taking possession of the place. They were accompanied by a formidable bodyguard in the person of Ernie Pannell, former All-American tackle from Texas A & M, and the orgy of reminiscence that was precipitated was something terrific. Ernie had just witnessed his first horse race—at Santa Anita—and the obliging equines had done a commendable job of carrying his mazuma first past the winning post on their accommodating noses. He was thus in generous mood, and even promised to let Larry win their next golf game.

Larry and Ernie are both with Hillman-Kelley at Houston, and are war buddies from the South Pacific, where they were active in the PT boat detail in the rugged early days of the New Guinea campaign—and from there on. We are informed by one of our Mid-Continent operatives that if Notre Dame beat SMU, Larry Kelley will own about half the state of Texas. Since Notre Dame is his alma mammy he has not hesitated to risk a bundle of chips whenever and wherever the opportunity presented. This will help to pay for a couple of wildcat operations that were performed simultaneously on his anatomy a short time ago, and will perhaps also help to compensate for the avalanche of wisecracks with which he was at the time assailed. All, of course, provided that Notre Dame can handle SMU in their windup game of the season.

The Kelley brothers are sons of Grover Kelley of Hillman-Kelley fame, and are a likable pair of chaps who, although still young and collegiate looking, already have friends scattered throughout the oilfields of the United States, from Land's End to John O'Groats. They were both born in Los Angeles, but while Larry developed wanderlust and migrated to Notre Dame, Jim stayed home; grew into a rabid Trojan. Jim played rugby for USC and was a letter man in track—his specialty being the hurdles. He claims, indeed, that hurdle jumping is a mighty good exercise for a prospective oil man. He is the proud pappy of five children, and his hobby is college sports. The only thing he doesn't like about college sports, or so he tells us, is that he can never get them to go home before the milkman arrives.

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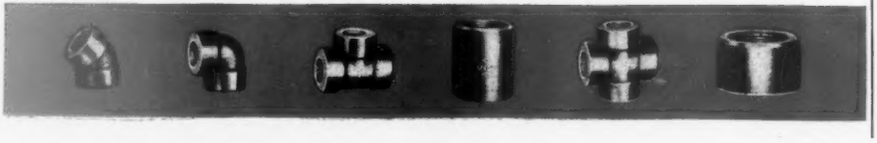

MEETINGS

1950

Jan. 9-13—Society of Automotive Engineers, Hotel Book-Cadillac, Detroit, Michigan.

Feb. 27-Mar. 2—American Society for Testing Materials, William Penn Hotel, Pittsburgh, Pa.

Mar. 8-10—API, Production Division, Southwestern District, Skirvin Hotel, Oklahoma City, Okla.

Mar. 27-29—Western Petroleum Refiners Assn., Annual Meeting, Plaza Hotel, San Antonio, Texas.

Mar. 29-31—API, Production Division, Mid-Continent District, Skirvin Hotel, Oklahoma City, Okla.

Apr. 3-6—National Assn of Corrosion Engineers, Jefferson Hotel, St. Louis, Mo.

Apr. 12-14—National Petroleum Assn, Hotel Cleveland, Cleveland, Ohio.

Apr. 13-14—API Production Division, Rocky Mountain District, Gladstone Hotel, Casper, Wyoming.

Apr. 23—Society of Exploration Geophysicists and Society of Economic Paleontologists and Mineralogists, Annual Meeting, Chicago, Ill.

Apr. 23—American Assn of Petroleum Geologists, Chicago, Ill.

Apr. 26-28—API, Production Division, Eastern District, Cleveland Hotel, Cleveland, Ohio.

May 1-4—API, Refining Division, Hotel Cleveland, Cleveland, Ohio.

May 7-9—Independent Petroleum Association of America, Mid-Year Meeting, Biltmore Hotel, Los Angeles.

May 11-12—API, Production Division, Pacific Coast District, Biltmore Hotel, Los Angeles, Calif.

June 19-24—Canadian Gas Assn Annual Meeting, Manoir Richieu, Murray Bay, Quebec, Canada.

June 26-30—American Society for Testing Materials, exhibit of testing apparatus and related equipment, Chalfonte-Haddon Hall, Atlantic City, N. J.

Sept. 13-15—National Petroleum Association, Hotel Traymore, Atlantic City, N. J.

Sept. 25-27—The American Society of Mechanical Engineers, The Roosevelt, New Orleans, Louisiana.

Nov. 13-16—API, Annual Meeting, Los Angeles, California.

NOMADS MEET

New York, N. Y., Chapter, First Monday of the Month, Louis Sherry's, New York, N. Y. Sec. Russ V. McIntire, 11 West 42nd Street, New York 18, New York.

Houston Chapter, Second Monday of the Month, Ye Ole College Inn, Houston, Texas. Sec. Harry E. Estes, P. O. Box 9321, Houston 11, Texas.

Los Angeles Chapter, Second Wednesday of the Month, Jonathan Club, Los Angeles, Calif. Sec. John W. Rife, 5905 Pacific Blvd., Huntington Park, Calif.

Tulsa Chapter, Third Wednesday of the Month, Hotel Tulsa, Tulsa, Okla. Sec. G. W. Davidson, Jr., Box 1188, Tulsa, Okla.

Dallas Chapter, Dallas, Texas, Jan. 9, 1950. Sec. C. J. Berlin, P. O. Box 2968, Dallas, Texas.

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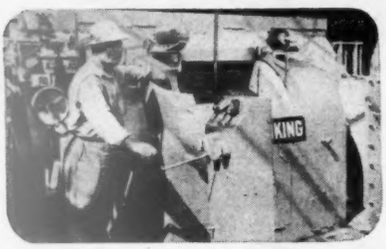

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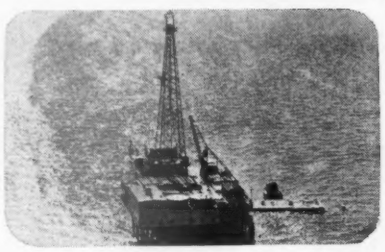
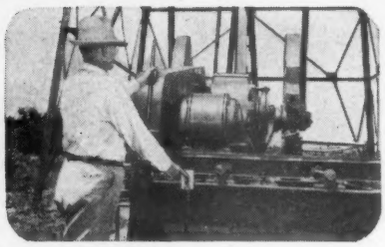
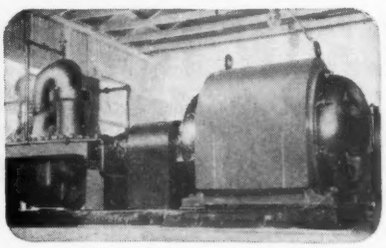
2 . . . the shortened rig-up time (above) that means a lower cost per foot of hole drilled. Concise, convincing and *impartial*, this film makes a full-color tour of successful producing fields, lets you see how electrification is cutting the cost of . . .



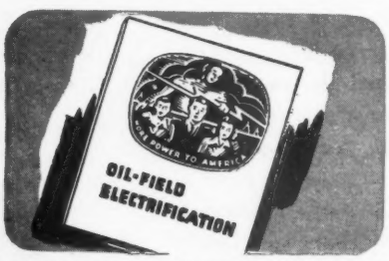
3 . . . off-shore drilling (above) where equipment flexibility makes the big difference. Moreover, you get plenty of solid facts on the economics of electrified pumping. For example, you're shown the limitless possibilities in cycle pumping.



4. You see how simple it is to start a motor-driven pump (above) and how you can counterbalance an electrified pump quickly and easily. Or, if pipelines are your business, you get an up-to-date picture of how operators, big and small, have . . .



5 . . . "motorized" pumps (above) for greater efficiency and lower maintenance. "Lease On The Future" is more than 25 minutes of entertainment—it can be a practical weapon in your fight to keep costs down. To convince you of this fact, we'd like to send you this . . .



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GENERAL ELECTRIC

LETTERS
to the Editors

To The Petroleum Engineer:

Since I am in the habit of reading with care the articles published in your review and by many other ones, I try to do, whenever an opportunity offers, a practical application of what I have learned in my reading, and so is the case of the article, "The Problem of Gas-Well Spacing," published in your Reference Annual, 1949, of "The Petroleum Engineer" (pg. A-83).

The author of the cited article said that the figures 1, 2 and 3 are based upon a field with given constant. I intended to try an application of the formula (8), replacing the letters with values reported by the author, but I am not able to arrive at the same results which one sees from the figures.

In consideration of this I examined attentively the paragraph, "Analytical Solutions," for making sure that was not a misprint in it.

I found no misprint, except the position:

$$\beta P_K = R_K$$

which, if $\beta = [\, A\gamma f(1-s)\,]^{-1} = \frac{1}{A\gamma f(1-s)}$ as reported in the list of symbols, is not right, and must be written:

$$P_K = \beta R_K$$

as the author does, however, in his formula (2).

I executed the integration of the formula (4)

$$t = \frac{1}{J\Phi\beta^2 a}\int_0^W \frac{dW}{(R_o - W)^2} = \frac{1}{J\Phi\beta^2 a}\left[\frac{1}{R_o - W}\right]_0^W = \frac{1}{J\Phi\beta^2 a} \times \frac{W}{R_o^2 - R_o W}$$

and from here:

$$W = \frac{R_o^2 J\Phi\beta^2 at}{1 + J\Phi\beta^2 a R_o t} = \frac{R_o \times R_o^2 J\Phi\beta^2 at}{R_o(1 + J\Phi\beta^2 a R_o t)} = \frac{R_o J C_j t}{R_o\left(1 + \frac{J C_j t}{R_o}\right)}$$

This equation coincides with equation (5) of your article, in fact if it is

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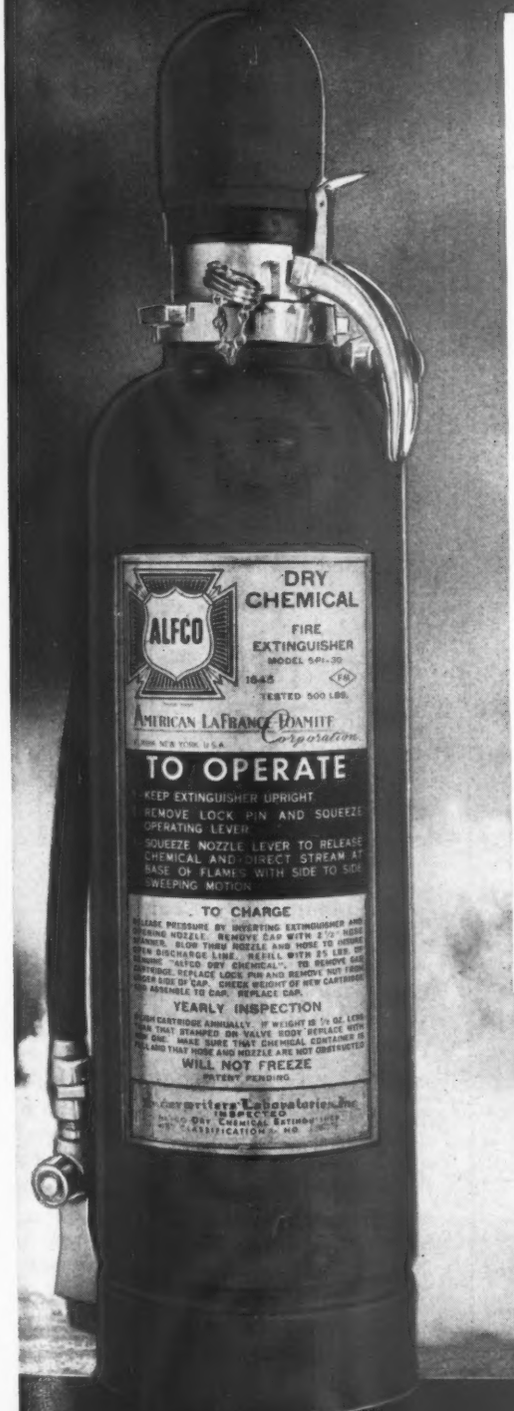

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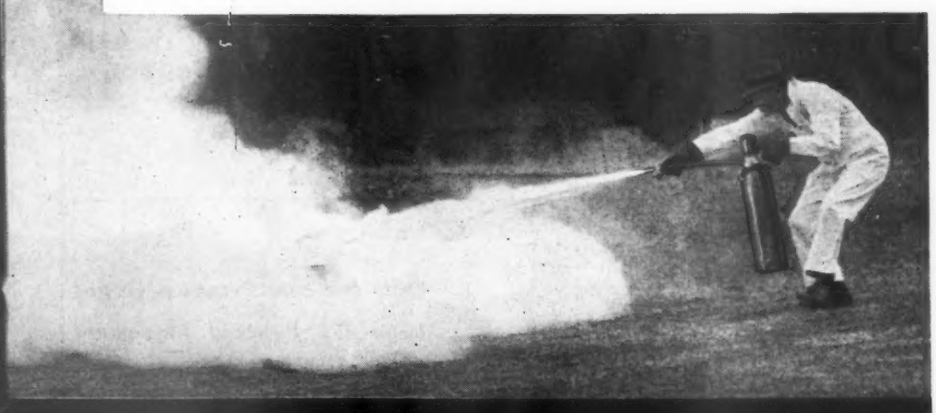

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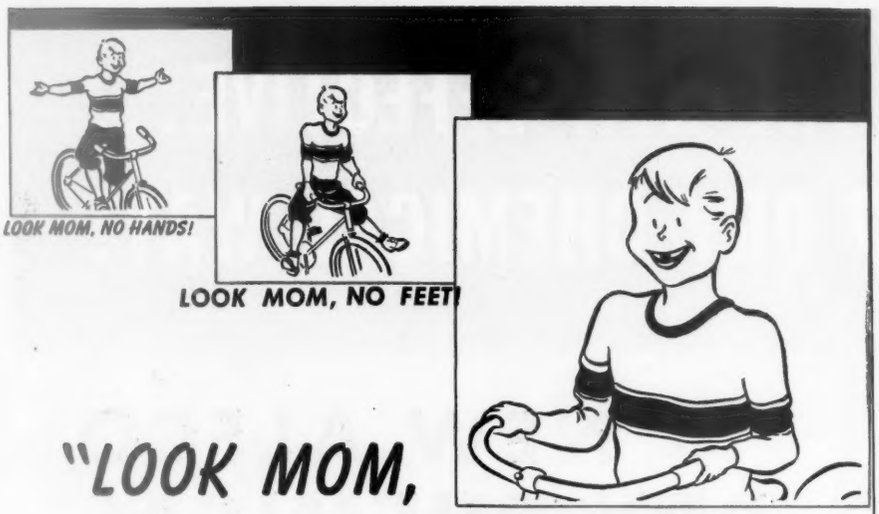

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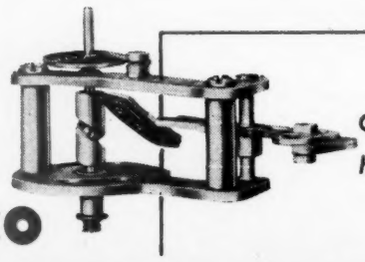

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put on equation (6) and then differentiated with respect to J, we obtain the formula (8) of the article in question.

But if we take now, and here is the weak point, the values proposed by the author i.e.:

$C_j = 10{,}000$ MCF/day

$\Psi = \$0.05$

$\Phi = \$100{,}000$

$\Theta = \$1000$

$R_0 = 100{,}000$ MCF

$t = (?) =$ days, years, hours?

1°) Time in years

$t = 10$ years

$$J_{max} = \frac{R_0}{C_j t}\left[\sqrt{\frac{\psi C_j t}{\Phi + \Theta t}} - 1\right] =$$

$$\frac{100{,}000}{10{,}000 \times 10}\left[\sqrt{\frac{0.05 \times 10{,}000 \times 10}{100{,}000 + 1000 \times 10}} - 1\right] = 1\left[\sqrt{\frac{5000}{110{,}000}} - 1\right] =$$

$$1\left[\sqrt{0.0454} - 1\right] = 1 \times (0.214 - 1) = -0.786$$

2°) Time in days

$t = 3650$ days

$$J_{max} = \frac{R_0}{C_j t}\left[\sqrt{\frac{\psi C_j t}{\Phi + \Theta t}} - 1\right] =$$

$$\frac{100{,}000}{10{,}000 \times 3650}\left[\sqrt{\frac{0.05 \times 10{,}000 \times 3650}{100{,}000 + 1000 \times 3650}} - 1\right] = 0.0027\left[\sqrt{\frac{1{,}825{,}000}{3{,}750{,}000}} - 1\right]$$

$$= 0.0027\,(0.699 - 1) = -0.0008$$

We obtain very strange results indeed! From figures 1, 2 and 3, we see that for the values above reported the number of wells is 8. Sirs, is it possible to have some information about this question?

Fortunati Federico
presso Societo Petrolifera Italiana
Foruovo Taro (Porena)
Italy

Editor's Note: D. T. MacRoberts, author of the article mentioned, states that if all figures be taken throughout in MCF—1000 cu ft—it makes no difference from then on whether days, years, or any other unit of time is used if it is used consistently.

$R_0 = 100{,}000$ MCF

$$J_{max} = \frac{100{,}000}{10{,}000 \times 10 \times 365}\left[\left(\frac{(0.05)\ (10{,}000)\ (10)\ )365)}{100{,}000 + 10{,}000 \times 365}\right)^{1/2} - 1\right]$$

THE Petroleum Engineer

DECEMBER
1949

Petroleum Conditions in China*

CAMPBELL OSBORN†

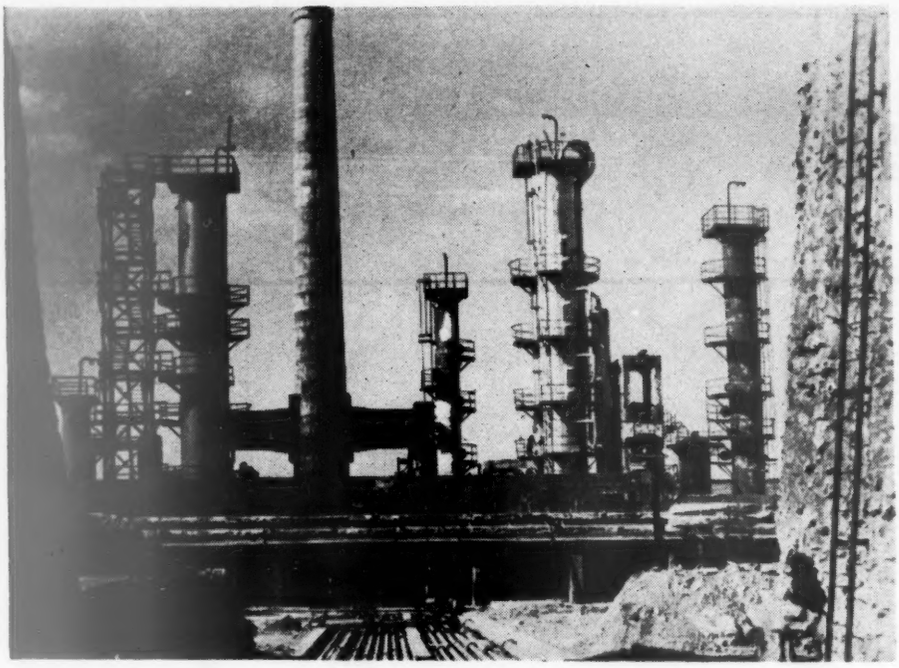
It is said that any westerner who attempts to write anything factual about China is either a novice or a fool. Nevertheless I think the American petroleum industry is entitled to the benefits of the information that came to my attention there in 1948 and 1949 while I was in charge of the program for meeting China's petroleum requirements of Paul Hoffman's Economic Cooperation Administration. At the risk, therefore, of being classified as an incompetent or a jester I will attempt to describe here what I saw, read, and heard about oil in Shanghai during the time the Reds were walking southward from Manchuria without opposition from Chiang's Nationalist "army" until they made it so uncomfortable for us that I resigned and took a plane to Tokyo for security.

To understand the petroleum situation in China requires some preliminary explanation. Though China has a fine ancient culture and philosophy, it is one of the most backward nations industrially and politically on earth. In it live about three times as many people as we have in the United States. A large percentage of them live in the congested coastal cities. Shanghai, at the mouth of the Yangtze River, is one of the world's worst slums. In an area not as big as Pittsburgh covers live 6,000,000 people. Ten per cent of the human race lives near the mouth of this great river. Last winter, without flood or famine, several hundred dead bodies were picked up in trucks each morning from the streets of Shanghai. Most of the freight in China is carried on the backs of the sweating peasants and coolies. China is an agricultural country. There are few railroads and very limited communication facilities. When you leave the cities roads disappear and footpaths take their place. Aside from the industries developed by the Japanese in Manchuria and the textile and food processing plants and the utilities in the big cities, China has little industry. They are a nation of merchants, farmers, and coolies. The philosophy of Confucius, the religion of Budda, and the family system have kept them together for 5000 years. They are the oldest nation in the world, but they care nothing for government. A full rice bowl and to be let alone with their families is all they ask. Chiang's Nationalist Government did not have the support of the Chinese people. They rallied behind him when the Japanese attacked them and when the war ended he lost their backing. His government was totalitarian and corrupt to the core. It supported the local war lords and the rich merchants and the accumulation of bureaucratic capital. The people knew their government was corrupt, but they shrugged their shoulders and said they could do nothing about it. No wonder his army did not resist the Reds. They took over China as fast as they could walk from one place to another. Allegedly to support the currency, but actually to fatten his regime, he talked the people out of their life's savings of gold and then moved it to Formosa and the United States. His trucks moving at midnight from the Central Bank of China in Shanghai kept me awake nights while I was living in the Cathay Hotel on the Bund. The International Settlement in Shanghai was once an orderly place. Now it is a bedlam of pedicabs and rickshaws with indiffer-

EXCLUSIVE

*This is the first of a series of three articles by the author on China, Japan, and the Near East. He has just returned from a period of three years work in the Orient, first in charge of the manufacturing industries of Japan on General MacArthur's staff, second the responsibility for Paul Hoffman's oil program in China amounting to $50,000,000, and finally as an observer of conditions in Persia and Arabia on his way home.

†Consulting Industrial Engineer, Washington, D. C.



No. 2 topping and cracking unit, Taiwan (Formosa) plant of Chinese Petroleum Corporation.

ent traffic regulations and irresponsible police. The Chinese speak three main languages, the most difficult on earth to learn, and only the well educated few understand each other unless they come from the same region. Only a comparatively small number of the Chinese people can read or write. Ghengis Khan could not successfully occupy China. Japan could not do it. Will Russia do it? I take the space to set out these facts in order to enable the reader better to understand petroleum conditions in the lands presided over by our Far Eastern ally of World War II.

General Oil Conditions

Obviously a nation in this condition, no matter what her reserves might be, can not produce substantial quantities of crude petroleum. Obviously also the requirements for petroleum products are not large. But the problem of getting them there and of distributing them and getting payment for them is difficult and complex. A medium-sized American petroleum refinery could supply everything required. Aside from aviation gasoline, the Continental Oil Company's plant at Ponca City, Oklahoma, or that of the Mid-Continent Petroleum Corporation in Tulsa could meet most of the Chinese requirements. As nearly as can be estimated, the total consumption in the last year or two was 15,000,000 bbl annually, or less than 1½ gal per year per capita. The value is roundly $50,000,000 per year. In prewar years kerosine accounted for 60 per cent of the imports, but recently with controlled economy, fuel and diesel oils and gasoline have been the main products imported. The Chinese Government has refused to make exchange available for kerosine and the teeming millions outside of the large cities supplied with electricity have had to substitute soybean oil or live in the dark.

Despite this change in the pattern of consumption, the volume of imports has steadily increased. Gallonage in 1947 and 1948 was nearly 100 per cent greater than in 1936, the last normal year. Shipments of coal were largely cut off and the utilities had to resort to fuel oil. The largest consumer of fuel oil in China is the Shanghai Power Company, an American owned corporation that burns oil in steam boilers. Civil aviation has made great progress in China during the past decade and the requirements for high octane fuel for this use have greatly expanded.

Until 1948 when ECA moved into the picture, practically all the oil used in China was supplied by three major marketing companies, The Texas Company (China) Ltd., known locally as Cal-Tex and owned by the Standard Oil Company of California and The Texas Company, the Standard Vacuum Oil Company, and the Asiatic Petroleum Company (Shell). All these companies have large investments in marketing facilities in the large cities of China. All are extremely efficient marketers and have carried the ball in supplying this unfortunate country with petroleum products under the most difficult conditions imaginable. I have the highest respect for their China managers, particulary Bates, Hudson, and Patton of the Shell, LeFevre, Beiling, and Holliman of Cal-Tex, and Mitchell and Sprague of Standard Vacuum. When you consider that profits could not be remitted if made, that the exchange was rapidly deteriorating daily, and that ECA's prices were fixed by statute at no more than charged other countries in a more normal condition, it was nothing short of a miracle that they kept the tankers coming into China ports and the lights and wheels going in the cities. Without their efforts the Chinese economy would have completely collapsed.

When I arrived in Shanghai about a year ago as ECA representative on petroleum the problems seemed insuperable. The Reds were marching southward from Manchuria. The policy was to keep the Nationalist areas supplied with needed oil products, but also to keep them out of the hands of the Reds. It was a hand to mouth proposition. Transportation was slow and difficult. Ships on the Yangtze were subject to shelling by Red guerrilla bands. We paid for the products in New York by cable and turned them over to the Nationalist Government—on paper only—and they sold them to the local marketing companies for the fluctuating local currency. We had a pricing committee that fixed prices daily based on a fantastic formula, but the best that could be devised, and the prices that came out looked like a rabbit out of a hat. A large element of the retail price was the cost of living index, which changed radically every two weeks, sometimes over 100 per cent. Although the overhead allowed for handling amounting to 10 or 12 cents per gallon looked ridiculous to a man whose experience in marketing had been confined to the Mid-Continent and Chicago markets, I am satisfied that the prices at which the products were sold to the Chinese consumers were not unconscionable and little or no opportunity was given to the Chinese bureaucrats to make a cut on the side.

Thanks also to the realistic policies of Paul Hoffman's organization in Washington, to Harland Cleveland, Gordon, Nason, and Mieklejohn of the China Air Program, and to the common sense of Roger Lapham and Allen Griffin in charge of the mission, we were able to keep the lights burning and the wheels going in China. Thanks to the cooperation of the oil companies, though sometimes tardy as is

human when dollars are involved, we were able to meet the rigid pricing regulations of ECA and to secure the documentation to support them for all products sold in the China market. When we left Shanghai we still owed Chiang's Nationalist Government more than $12,000,000 that it had spent for petroleum products after the passage of the China Aid Act by Congress that we were committed to reimburse. And there was not enough ECA financed oil left north of the Yangtze or in Shanghai for the Reds to take over to run the Shanghai Power Company or the Chinese airlines for a week. Irrespective of the wisdom of aid to the Nationalist Government, the ECA, acting in accordance with the mandate of Congress, tried to help our ancient friends, the Chinese people, in one of their darkest hours and under the most trying conditions, and kept them fully supplied with oil products until the Reds came into Shanghai, and then moved quietly out and left no oil loot in substantial quantities for the conquerors.

The Chinese Effort

There was little that the Chinese could do for themselves for the reason that they produce only three per cent of their requirements from local fields, and though they owned a modest-sized refinery on Formosa they were unable to finance its requirements for imported crude petroleum. It was the policy of ECA to encourage and aid the Chinese in doing as much for themselves as possible. Accordingly we financed the purchase of crude petroleum from the Near East in sufficient quantities to enable them to operate the Formosan refinery at a rate of 8000 to 10,000 bbl per day. It was believed that money spent in this way would yield more petroleum products than the same sums laid out for refined products and would otherwise help the Chinese economy. We met the resistance of the major marketers with this policy, but the arguments in favor of it were so strong that it was sustained in Washington. In this way the Formosan plant supplied something between 15 and 25 per cent of the oil requirements of China from imported crude up to the time Shanghai fell to the Reds. The plant was operated by the Chinese Petroleum Corporation, a Government corporation controlled by the National Resources Commission of the Nationalists. It was my position that after the fall of Shanghai, with the consequent restriction of markets in what remained of Nationalist China, this company if further financed would get an undue proportion of the business and this could not be justified in Washington. With the fall of Canton I feel quite sure now that this plant is getting no further shipments of crude oil from the Near East.

So much for the scrambled petroleum conditions in China during the fall of the Nationalist regime and the conquest by the Reds. The prospects for improvement are dim. Under the new regime, with no business experience and suspicion of those who have it, it seems certain conditions will grow worse. Eventually the teeming millions may absorb their Red brethren as they have every other influence that has come their way. Meantime the major oil companies have doubtless temporarily written off their large investments in Chinese marketing facilities and good will.

Reserves and Production

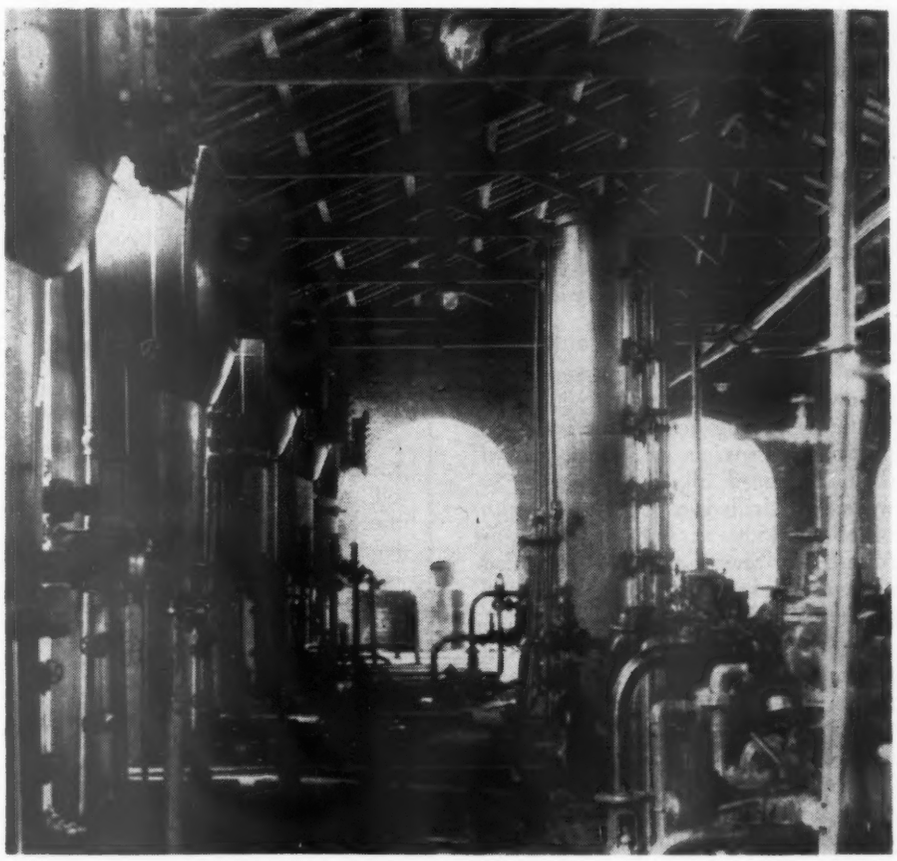
Let's forget the political situation and take a look at the reserve, production, refining, and marketing aspects of the Chinese picture abstractly. Some day they may have a practical interest to American oil men not already involved in the Chinese puzzle.

Topographically and geologically China is a big country. It is not like its neighbor Japan, a volcanic country overlain by igneous rocks smaller than California and with little prospect for petroleum production. It has the large basins, areas favorable for origin and accumulation, folding and faulting, anticlines, synclines, domes, terraces, and other geological formations that we have in the states. It has always been looked upon with more or less disfavor by petroleum geologists because of the meager information revealed by drilling. But the geologist is conservative. Oil and gas have been produced in several widely separated places in China and with enough geological exploration and drilling it is my personal opinion many large fields would be found. It may be in the same position with respect to oil production that America was at the time of our civil war. Perhaps it has the same prospects for future production.

The Kansu Area

Oil in commercial quantities was discovered about nine years ago in Kansu Province of north central China. This province is in the great Mongolian Highland, a region regarded by Chinese geologists as favorable for petroleum discovery. The most productive spot is known as the Lao Chun Miao field. Up to 1948, 44 producing wells had been drilled. The drilling was done by a government corporation. It is said not less than 10

Chemical processing equipment in the Taiwan plant.



favorable structures have been indicated by drilling in Kansu Province and the adjoining Province of Tsinghai. The producing zone in the Lao Chun Miao field is of Tertiary age, the structure a dome, and the producing horizon unconsolidated sand. Production was found at levels of 500 to 1000 ft. The thickness of the sand is 50 to 100 ft. According to the Chinese Natural Resources Commission, the proved area in Kansu Province is 2280 acres and the reserves 26,000,000 bbl. Up to October, 1948, 3,180,000 bbl had been produced. The initial daily output ranged from 480 to 2000 bbl.

The Szechuan Gas Area

Natural gas has been produced and used commerciallv from the Szechuan basin in central China for hundreds of years. The basin extends over an area of some 75,000 sq miles. Only five wells have been drilled. The gas is produced with brine from Triassic limestone at depths of 2000 to 4000 ft. The estimated area of the proved structures is 14,000 acres.

The Formosan Fields

Small amounts of commercial petroleum have been produced in Formosa for many years. Not less than 35 possible structures have been discovered on the island and 7 have been proved to contain oil. There are two districts, the Miaolee and Sinving, and they have 34 producing wells. The production comes from anticlinal structures of Tertiary age but the saturation is low. The total daily output is 50 bbl. When the Japanese were in possession of Formosa they drilled 214 holes, but through ignorance of production technique got water where oil production could have been developed. The reserves of proved fields are estimated at 10,000,000 bbl and the prospects of finding additional production are good.

Other Favorable Areas

In 1906 a Japanese engineer drilled four wells in the search for petroleum in the Yenchang area in the northern part of the Province of Shensi. Two of them produced oil. Subsequently 24 wells were drilled by others to a depth of about 3530 ft, but little oil was found. The Shensi region is regarded as favorable by Chinese geologists and further search is justified.

Showings of oil during the Ching Dynasty were found in the Sinkiang region of northwest China at Tushantze of Wusu, Tungchang of Kucheh, and Taclak of Wensu, but only one has been exploited, that is the Tushantze area. Twenty-four wells have been drilled, the deepest about 3000 ft, and some of them had initial production of 200 to 300 bbl, but depleted rapidly. Further prospecting is warranted in this vast region. Oil was discovered by the Japanese in the Fusin district of Jehol Province during their occupation and 81 wells were drilled but only 10 per cent of them yielded production.

The Refining Situation

There are two refineries in China, one in Kansu Province processing presumably the output of the local field amounting to about 1200 bbl per day and making gasoline, kerosine, diesel, and fuel oil, and the other at Kaohsiung in Formosa or Taiwan making the same products. Both are skimming and cracking plants. Gasoline production in the Kansu plant in 1948 was 180,000 bbl. Distribution was local. Both plants were operated during 1948 and early 1949 by the Chinese Petroleum Corporation, owned by the Nationalist Government.

The refinery at Kaohsuing was built by the Japanese Navy during World War II to process local and East Indian crude, which they hoped to import. At the end of the war this plant came back into China's possession and they attempted to operate it in 1947 with rather indifferent results because of the damage done to it by our bombing and lack of capital to buy crude petroleum. By the early part of 1948, however, with the aid of the Universal Oil Products Company, the plant had been reconstructed and later was put into operation with ECA financing. It consists of a No. 1 skimming unit with a capacity of 7500 bbl per day and a No. 2 skimming and cracking unit with a capacity of 8300 bbl of crude and 4000 bbl of topped crude. At the time the Reds took over Shanghai in the spring of 1949 this plant was processing about 10,000 bbl per day of crude that we purchased for them from Persian Gulf sources. The yield of gasoline was 22 per cent, kerosine 17 per cent, diesel oil 7 per cent, and fuel oil 50 per cent. The crude was of inferior quality and consequently the products were high in sulfur, but had a ready market in China where quality was not so important as price. The accompanying illustrations marked Figs. 1, 2, and 3 illustrate the No. 1 topping unit, the combination skimming and cracking unit, and the chemical treating equipment of the Taiwan plant.

Before Shanghai fell this company enjoyed about 15 to 25 per cent of the China market, which was not an unreasonable portion for this government to finance, considering the financial advantage to China to import and process crude rather than buy more expensive refined products. With the fall of Shanghai it was obvious that the markets available to the Nationalists would be so restricted that this plant, even if operated at the rate of 5000 bbl daily, would enjoy an undue proportion of the market, and I recommended that it be shut down. With the fall of Canton and only the small Formosan market left and little prospect of getting into the export market. I assume this has now been done, and that the only oils that are now being consumed in China are being purchased in some way by the Reds from the big three marketers or taken from the stocks accumulated on the mainland in the tanks of the Chinese Petroleum Corporation.

Summary of Conclusions

During the past two years, as nearly as can be determined, the consumption of petroleum products in China was about 15,000,000 bbl per year, or about 1½ gal per capita. This low consumption may be ascribed to lack of industrial development, scrambled political conditions, financial troubles, scarcity of roads, motor vehicles, and industrial consumers, and to war damage. The products have been financed by the American and Chinese Governments and supplied by the big three marketers and the Chinese Petroleum Corporation. Although potential reserves may be large, little has been done to develop them, and there are no prospects that a radical change will soon occur in this direction. The Taiwan refinery is capable of supplying a large part of China's oil needs provided finances are available to buy crude oil from the Near East, but this seems unlikely. Under peaceful and settled conditions the future consumption of petroleum products in China might be much larger than they have been, but until such time a decrease is to be expected, and the companies that undertake to supply China's markets will suffer many headaches. * * *

"Rock Oil" Was First Product

In 1859 there was only one principal petroleum product: Kerosine. They call it "rock oil" and used it in lamps. Today there are more than 1200 petroleum products.

Oil has become a major source of raw material for America's rapidly expanding chemical industry. From oil comes synthetic rubber, fertilizers, industrial alcohols, and commercial solvents.

Although the United States contains only one-eighth of the potential oil lands, it has produced two-thirds of world's oil.

OIL IN VENEZUELA[1]

JOSEPH E. POGUE

PART 3—Conclusion

The Energy Circuit

We have presented an analysis of the five ingredients entering into oil in Venezuela—the Resource, the Industry, the Market, the State, and the Economy—much as an architect might assemble the specifications of his building materials. But the mere cataloging of these factors is not sufficient. It is desirable to ascertain how they are joined together, the manner in which the combination operates, and what it is that imbues the system with activity and growth. Perhaps this inquiry may best be approached by means of an analogy.

Everyone is familiar with the electric circuit—the manner in which energy in the form of heat is derived from fuel, converted into a mysterious essence called electricity, transmitted along wires to distant points, altered en route into various intensities, and finally transformed into heat, light, and power. This series of steps constitutes a conventional form of energy circuit. The natural laws governing its operation are well established. The management of the system requires specialized competence and unremitting attention. At every stage there is friction and leakage, but the engineer seeks to keep these losses at a minimum, while technological research is constantly making advances which reduce such wastes. At any point there may develop a "short" which diverts the energy from its course. These short-circuits are immediately sought out and corrected, for such gross losses cannot be countenanced.

Oil production in Venezuela operates on an economic circuit having many points of similarity to the more familiar electric circuit. The latent energy in petroleum is carried through special forms of transportation to the markets of the world where it is converted into money most of which returns to the country directly and indirectly to maintain and expand the productive enterprise, to pay those engaged in its operation, and to set in motion other activities in the country. Oil as a commodity is consumed in the process, becoming transferred into heat, light, power, and many useful products, but part of the economic energy, or money, generated from the oil survives current consumption and finds its way into replacing the oil utilized and creating additional productive interprises. In this way, the oil circuit perpetuates itself and gives rise to new circuits.

Let us examine the operations of the Venezuelan oil industry for the years 1943-1948, in order to ascertain the pattern of its energy circuit. (See Fig. 10.) In this period about 2058 million barrels of oil were produced and sold in the market for the equivalent of 3148 million dollars. Between one and two per cent of the total oil was consumed in Venezuela and therefore was converted directly into bolivars which returned to the money stream. This portion contributes to the economy directly by promoting automotive transportation. Therefore its consumption has a creative aspect.

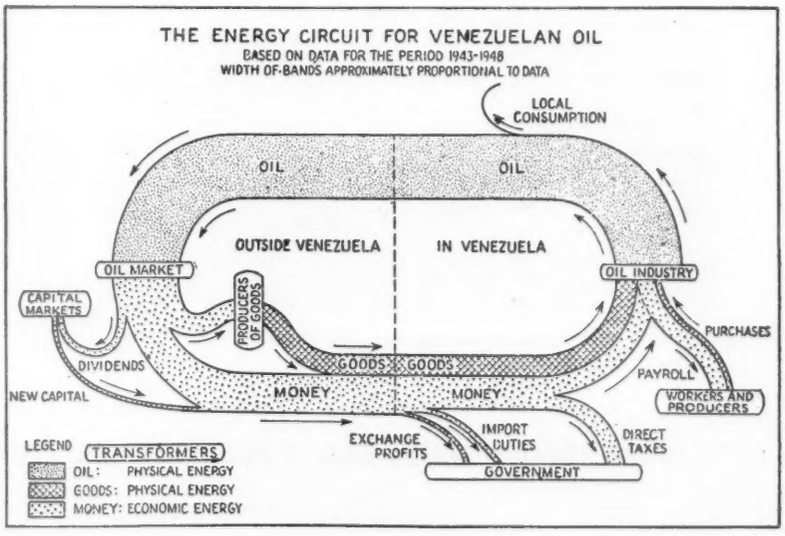
The remainder of the oil proceeded to foreign markets and was there exchanged for the equivalent of 3070 million dollars.[12] These dollars thereupon started upon their return journey to Venezuela. Fourteen per cent of them were detoured in the form of dividends which were disbursed to those who supply the capital. These payments perform a several-fold purpose: they constitute a return on the capital employed; contribute some measure of amortization for this capital; and also, if adequate, stimulate additional investments in oil and in other activities in Venezuela. A measure of their new investment effect is afforded by the fact that the amount of new investment capital entering the industry represented 82 per cent of the capital withdrawn as dividends. Accordingly, only 82 million dollars, or 2.6 per cent of dollar sales, constituted a net deduction from the return flow of dollars. In addition, another very small amount, not over a few per cent, was used to cover expenses en route.

In the return journey followed by the sales dollars, a portion of them, approximately a third, was converted into supplies, materials, machinery, and other goods which were shipped to Venezuela as part of the stream of values and there utilized for replacing the capital consumed in oil operations and for expanding oil activities. At the country's boundary, these goods were subjected to import taxes.

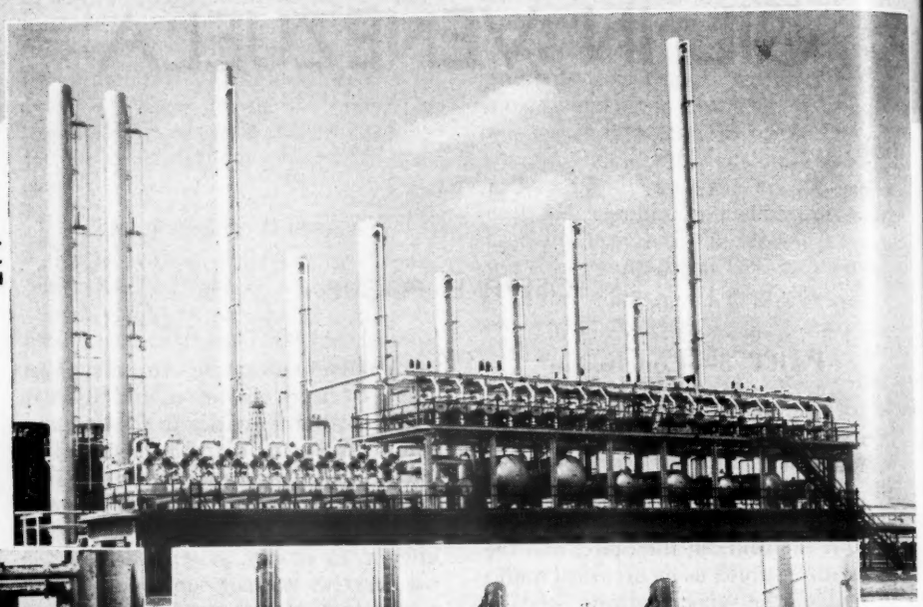
The remainder of the money, ap-

12. This amount excludes the estimated receipts from sales made in Venezuela and the government royalty oil taken in kind. The existing data do not permit precise statistical accuracy in this circuit analysis, but the arithmetic divergencies from the facts are small and do not impair the general contours of the pattern.

FIG. 10. Diagram showing in generalized form the oil energy circuit for Venezuelan petroleum. The channels indicate the outflow of petroleum and the return flow of oil goods and money, along with the various side movements from the main channels.

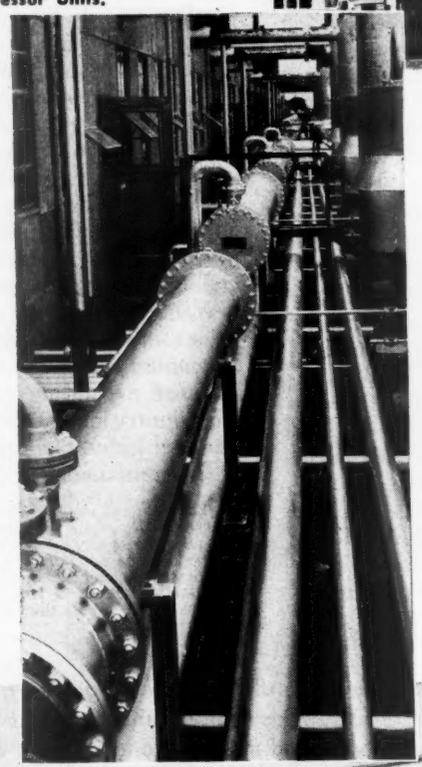


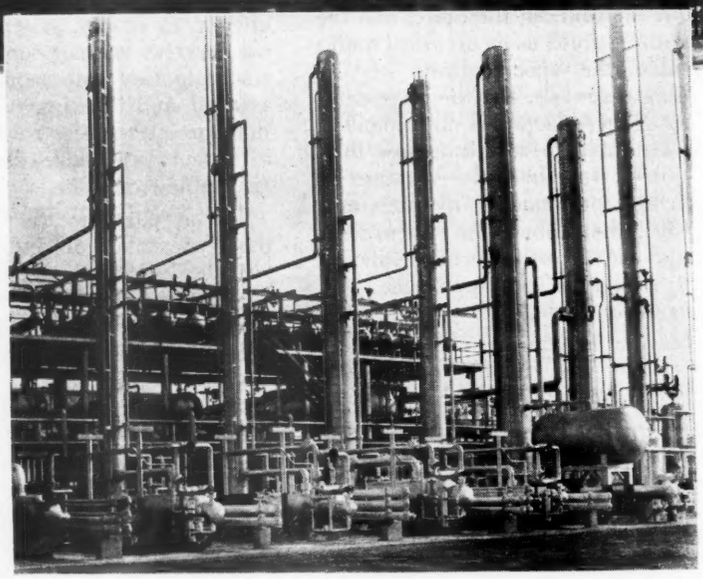
1. This paper was first published by The Chase National Bank of the City of New York, of which the author was vice president.



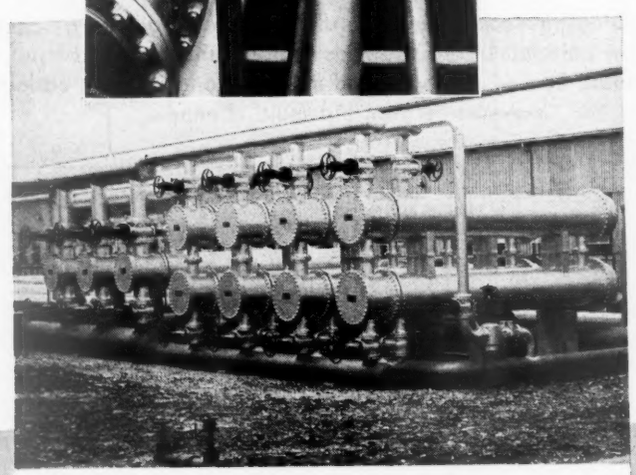
Batteries of G-R Main Still, Primary Still, Deethanizer, Debutanizer, Depentanizer, and Splitter Condensers.

G-R Jacket Water Coolers for Power Cylinders and Compressor Cylinders of Diesel Engine-driven Compressor Units.

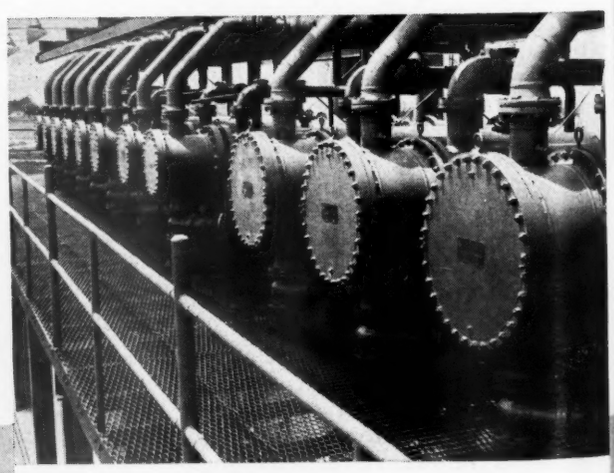




Group of G-R U-Tube Reboilers, and stacks of G-R Twin G-Fin Sections serving as Feed Exchangers and Product Coolers.



Some of the G-R Lube Oil Coolers for the Compressor Units.



Close-up View of the stationary head ends of some of the G-R Condensers shown in illustration at upper right.

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- 1—CSU Splitter Reboiler
- 2—FGT Deethanizer Condensers
- 2—Twin G-Fin Section Deethanizer Feed Exchangers
- 1—CSU Deethanizer Reboiler
- 2—FST Depropanizer Condensers
- 3—Twin G-Fin Section Depropanizer Feed Exchangers
- 1—CSU Depropanizer Reboiler
- 2—FGT Debutanizer Condensers
- 2—Twin G-Fin Section Debutanizer Feed Exchangers
- 1—CSU Debutanizer Reboiler
- 2—FST Depentanizer Condensers
- 2—Twin G-Fin Section Depentanizer Feed Exchangers
- 1—CSU Depentanizer Reboiler
- 3—FGT Primary Still Condensers
- 3—FGT Main Still Condensers
- 2—Twin G-Fin Section Propane Coolers
- 1—Twin G-Fin Section Propane Dehydration Regeneration Gas Reheater
- 1—Twin G-Fin Section Mixed Butane Cooler
- 3—Twin G-Fin Section Debutanizer Bottoms Coolers
- 2—Twin G-Fin Section Isopentane Final Coolers
- 3—Twin G-Fin Section Gasoline Coolers
- 4—FST Rich Oil Preheaters
- 3—Twin Bare Pipe Section Regeneration Gas Coolers
- 2—Twin Bare Pipe Section Regeneration Gas Heaters
- 2—Twin Bare Pipe Section Reabsorber Intercoolers
- 8—FST Main Oil Exchangers
- 12—FST Compressor Lube Oil Coolers
- 8—FST Compressor Jacket Water Exchangers
- 3—FST Engine Jacket Water Coolers
- 1—H Bentube Feedwater Evaporator
- 1—F Drainer
- 1—K Level Controller
- 3—Twin Bare Pipe Section Steam Condensate Exchangers
- 2—Twin Bare Pipe Section Condensate Coolers

GR-238

proximately two-thirds of the original amount, proceeded to Venezuela as such. At the frontier these dollars were converted into bolivars. The mechanism used in this transformation is the Banco Central which purchases the dollars from the oil companies at 3.09 bolivars to the dollar and sells them to national commercial interests for 3.35 bolivars to the dollar, thus realizing a substantial gain on the transaction.[13] This profit is in the nature of a hidden tax on oil production. In the case of local coffee and cocoa producers, the Banco Central pays 4.25 bolivars per dollar.[14] Thus, in a sense, oil production is called upon to subsidize the production of coffee and cocoa.

Once within the country the original stream of dollars and oil-goods, the former reduced by the processes of entry, continued on its way to the oil fields. En route, in effect, the funds were subjected to the various forms of direct taxation levied by the Government which aggregated the equivalent of 1131 million dollars, or about 36 per cent of the original amount of sales dollars. These taxes made up 68 per cent of government expenditures. To the extent that the tax receipts were expended for current operations and other immediate consumption purposes, they served a one-time use—and disappeared from existence. Part of them, however, went into the development of facilities and services creative of production and became generative. Obviously, the economy will be fundamentally improved in direct proportion to the share of federal revenues devoted to productive purposes and the volume of goods and services which can be purchased by such funds.

Finally, the residual amount of the original sales dollars, about one-third of the initial total, reached the oil operations. After purchases of materials, the remainder was converted into work and returned to the economy in the form of payrolls. This sum was devoted almost entirely to immediate consumption. Thrift accounts have been initiated by the oil companies, but the mechanics of savings are not well advanced amongst Venezuelan oil workers and therefore the payroll fund has thus had very little regenerative value in the direction of new investments. Here, again, is an avenue for advancement.

This broad survey of oil in terms of its energy circuit emphasizes the large diversion of economic energy from its normal course into governmental channels. From the point of view of lasting good to the economy, the question arises whether the centralization of so much energy is a wholly desirable feature. At least, this pattern involves a responsibility to make sure that policies do not lead to a weakening of the competitive position of Venezuelan oil in world markets and to over-concentration of the diverted funds on purely short-term objectives.

The force which animates the energy circuit and drives it forward is human energy, which is stirred into action and directed by the hope for gain—the profit incentive. This motive is one of the basic human instincts and, judging by results, finds its most effective expression in the structure of competitive individual enterprise. The petroleum industry offers a singularly clear manifestation of this principle, for throughout the world the rate of oil production is a direct function of the freedom of the individual to exercise his initiatve. Venezuela is deemed to be fortunate in having entrusted its oil development to a type of organization so fruitful of demonstrated results. Where enterprise in oil has been hampered in its freedom of action or centralized in the state, the outcome has invariably been disappointing.

The measure of effectiveness in the impact of economic energy upon an economy is *capital formation*, the process whereby industrial progress and growth are achieved. The nature of this mechanism has been implied in the foregoing discussion, but the importance of the concept requires a more extended treatment.

Capital Formation

We have outlined how oil moves out of Venezuela to the markets of the world and is there converted into money, over 80 per cent of which returns to the country in the form of oil goods and monetary units. The returning stream of values is partly exhausted in current consumption and partly transformed into productive assets. The part devoted to creating further production represents the capital formed in the process. *Capital formation is therefore the resultant of savings, the excess of production over consumption, and involves some measure of current abstention and sacrifice in favor of future satisfaction.* This principle is equally true of the investor, the industry, or the nation.

The measurement of the capital formed within the oil industry requires special information because conventional income statements and balance sheets are not suitable for revealing the flow of capital through the system and separating that which is used in current production from the part which goes into replacement and expansion of facilities for future production. In addition there is a series of conversions from monetary to physical capital which is apt to prove elusive to the investigator. Nevertheless, an inquiry into these matters is essential to an understanding of the industry, and the techniques have been developed in connection with studies of the petroleum industry of the United States.[15] To this end arrangements were made with an independent auditing firm to gather in appropriate form the relevant financial results of the operation of 12 Venezuelan oil companies covering the years 1943 to 1948.[16] These companies produced over 99 per cent of the total oil output of Venezuela and therefore the findings may be accepted as representative of the whole industry. The information now available makes possible for the first time a quantitative analysis of capital formation in the Venezuelan oil industry.

The procedure, reduced to its simplest terms, is to ascertain at the outset the gross income derived from the sale of oil and the sum of the cash expenses and tax payments incurred in its production, transportation, and refining up to the point where it leaves the country. The difference between these two items is cash income. This sum is then segregated by accounting procedures into two parts. One part is called capital extinguishments (depreciation, depletion, etc.) or non-cash charges, and represents an amount originally designed to replace the capital used up and worn out in the productive processes. The other part, which is cash income minus capital extinguishments, is called net income and is the item commonly thought of as profit. The validity of net income depends upon the accuracy with which the capital extinguishment account is estimated. Based upon historical costs, this account is bound to be inadequate when prices of goods and labor are trending upward. The cash income, however, is always a directly measurable figure.

The next step is to add to the cash income the outside capital borrowed,

13. In the interest of simple exposition, these figures are somewhat generalized but the results are substantially as indicated.
14. For washed coffee the rate of exchange is 4.80 bolivars per U. S. dollar; for husked coffee, 4.25 bolivars per U. S. dollar.
15. See Pogue and Coqueron, *Financial Analysis of Thirty Oil Companies for 1947*, published by the Chase National Bank in September, 1948.
16. In this compilation, every effort was made to gather homogeneous figures and to arrange them in the usual accounting categories. Accounting practices are not in all cases entirely uniform, but the results are believed to represent reasonably uniform and consistent principles. The terms employed are those commonly in use. For example "dividends" denote "payments to owners" and include the outflow of funds from the industry; "capital extinguishments" mean "non-cash charges for depletion, depreciation, and the like"; etc.

raised through the sale of stock, or otherwise obtained. The sum of these amounts constitutes the available capital funds. From this total must then be deducted dividends, the term here used to cover payments to the owners of the capital. The remainder is then available for capital expenditures or working capital. The former application represents a conversion of capital funds into physical assets and completes the initial cycle. The expenditures for plant, facilities, and oil reserves are designed for future production and therefore they generate a new cycle of production. This process must continue from year to year, if operations are to expand or even to be maintained in a sound condition. A lapse in capital formation results in the depletion of capital resources and is retrogressive. This condition is known as living on capital.[17]

In Table 12 and Fig. 11 there are shown for a period of six years the sources of capital funds—net income reinvested, capital extinguishment charges, and new capital obtained (increases in debt and capital). The upper part of the table and chart reveals that a growing share of the net income was ploughed back into the business. The necessity for this increasing diversion into capital assets is indicated in the middle part of the table and chart, where the large and expanding difference between the amount of capital expenditures and the charges for capital extinguishments is illustrated. Obviously, net income had to be invaded to supplement the funds needed for capital expenditures, and in some proportion to this circumstance it is improper to regard net income as synonymous with profit, since only a small part was available for disbursement in the form of dividends. Finally in the bottom part of the table and chart the dividend outflow and new capital inflow is depicted for the system. The difference between the two is small and the two almost cancel out.

Table 13 presents a flow sheet of the source and disposition of funds in comparative form. For the period, 1943-1948, net income totalled 971 million dollars; capital extinguishment charges, 428 million dollars; salvage recovered, 35 million dollars; and increase in debt and capital (external funds obtained), 362 million dollars. Thus the aggregate of capital funds was 1796 million dollars. Of this amount, 1275 million dollars, or 71 per cent, went into capital expenditures; 77 million dollars into working capital; and 444 million dollars

17. In these two paragraphs we have purposely oversimplified the explanation in the interest of clarity. A technical presentation would involve the entire theory of accounting.

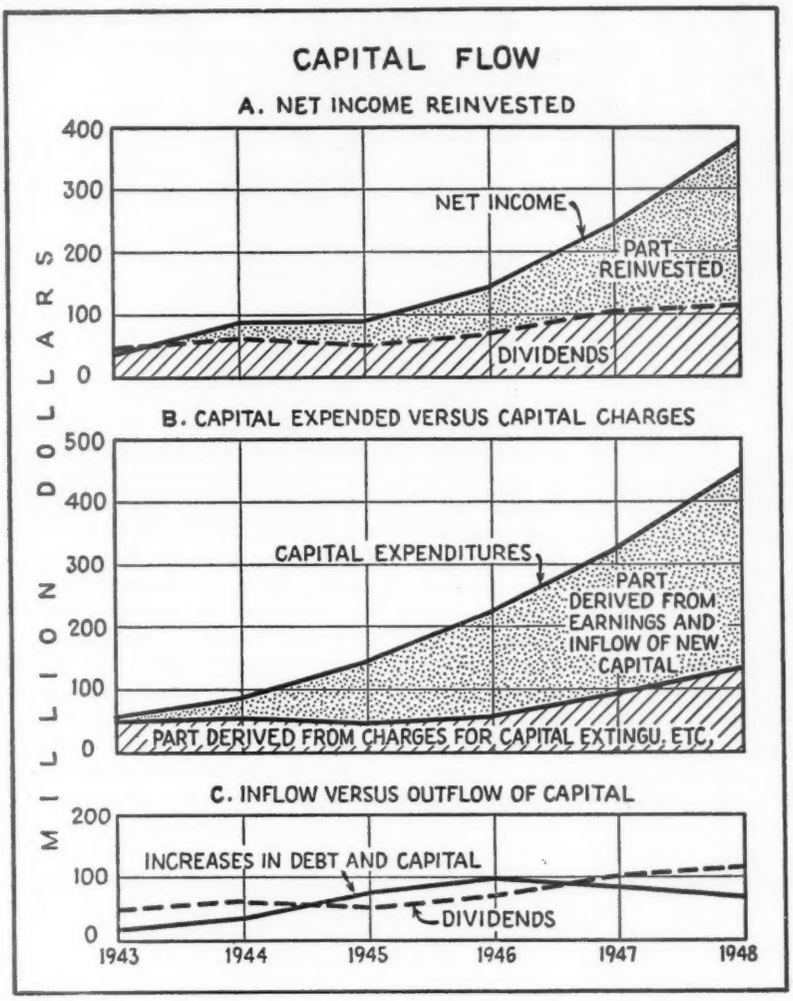


FIG. 11. Flow of capital in the Venezuelan oil industry, showing how a large part of net income is required for capital expenditures, by years, 1943-1948. For data see Table 12.

TABLE 12. Amount of net income reinvested, disparity between capital expenditures and capital extinguishment charges, and relation of dividends to new capital raised, twelve Venezuelan oil companies, by years, 1943-1948 (in millions of dollars).

	1943	1944	1945	1946	1947	1948	Total for period
Net income reinvested							
Net income ("profits")	32	84	89	143	246	377	971
Dividends	46	62	50	69	103	114	444
Amount reinvested	—14	22	39	74	143	263	527
Per cent reinvested	...	26	44	52	58	70	54
Disparity between capital expenditures and capital extinguishments							
Capital expenditures	52	86	142	221	322	452	1,275
Capital extinguishments, etc.	49	51	49	58	91	130	428
Excess of capital expenditures	3	35	93	163	231	322	847
Relation of dividends to new capital raised							
Dividends	46	62	50	69	103	114	444
Increases in debt and capital (net)	15	35	74	99	73	66	362
Excess of dividends	31	27	—24	—30	30	48	82

into dividends. Thus it may be said that 71 per cent of the cash produced by the oil industry of Venezuela during the past six years was reinvested in the business and constituted a measure of the amount of capital formed. This sum was 40 per cent of the gross income obtained from the sale of oil. In other words 40 cents out of every dollar obtained from the sale of oil were ploughed back into the business.

Capital formation in the petroleum industry of Venezuela is graphically compared with that revealed in the accounts of 30 United States oil companies in Fig. 12. The flow of funds covering the past six years is shown for the two groups. It is clear that the processes are very similar in the two countries, with much the same relativities as to source and disposition of capital funds. This similarity may be taken to indicate the world-wide incidence of the forces affecting the two industries and the fundamental nature of the productive mechanism which has like manifestations under unlike settings. The aspects of greatest difference are the higher proportion of external funds required by the Venezuelan petroleum industry, and the smaller proportion of capital extinguishments appearing in the accounts of the latter.

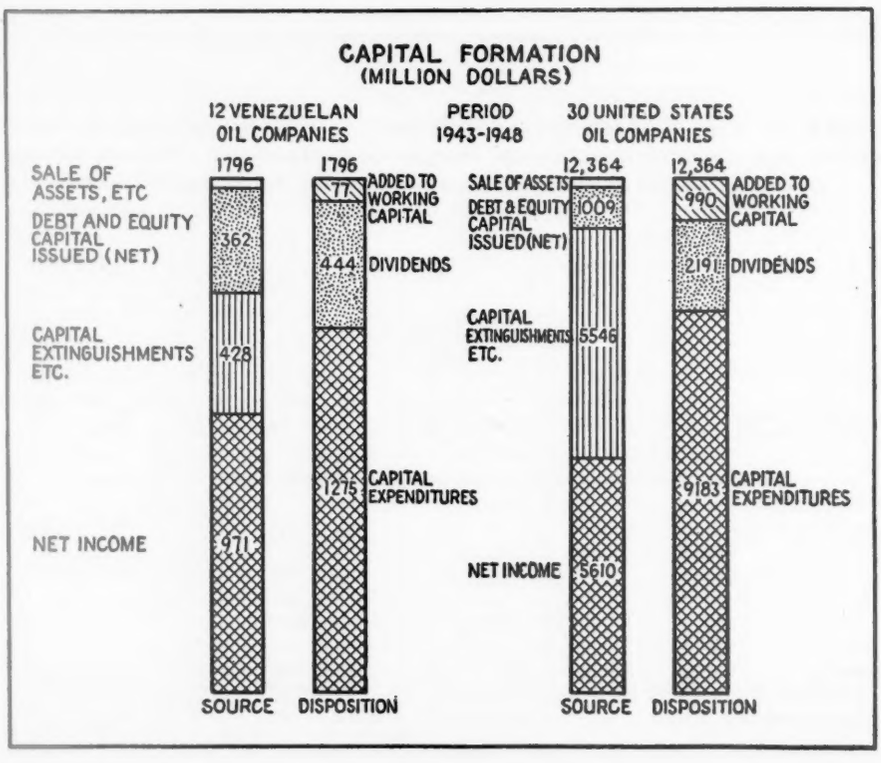
In the development of the Venezuelan oil industry the formation of capital has followed a normal evolution. In the early stages, the necessary capital was obtained from savings of corporate and individual investors foreign to the locale. Later on, the industry itself attained sufficient size and strength to generate out of its earnings a large portion of the additional capital needs, although an inflow of external capital still continued, particularly on the part of new entrants into the field. But it should be noted that in the case of an oil exporting economy, the self-generation of capital involves an exchange effected outside the country and the funds utilized in capital formation are still derived from abroad with the foreign consumer as the source.

TABLE 13. Source and disposition of funds of the Venezuelan oil industry by years, 1943-1948 (in millions of dollars).

	1943	1944	1945	1946	1947	1948	Total for period
Source of funds							
Net income	32	84	89	143	246	377	971
Capital extinguishment charges, etc.	49	51	49	58	91	130	428
Salvage recovered	3	6	6	7	5	8	35
Increase in debt and capital	15	35	74	99	73	66	362
Total funds available	99	176	218	307	415	581	1,796
Disposition of funds							
Capital expenditures	52	86	142	221	322	452	1,275
Changes in working capital	+1	+28	+26	+17	−10	+15	+77
Dividends	46	62	50	69	103	114	444
Total funds disposed	99	176	218	307	415	581	1,796

This analysis may suggest how capital may be formed in directions other than oil. It is not the proper function of the oil industry to engage in activities external to its sphere. Sufficient that the industry performs its internal task of capital formation adequately. But the government can promote capital investment in other directions by an enlightened attitude toward capital formation in oil, thus encouraging other investors; and by steering its own expenditures to ends leading to production rather than consumption. And the same is true of the funds disbursed by the oil industry in the form of payrolls. These now go almost entirely into current consumption. If mechanisms and incentives for savings can be developed, then these payments may begin to contribute investments to the economy. In these ways, capital formation in the oil circuit may lead to the creation of new circuits. Should the formation of capital be hampered in oil, by the same token the process would be hindered in innumerable other directions.

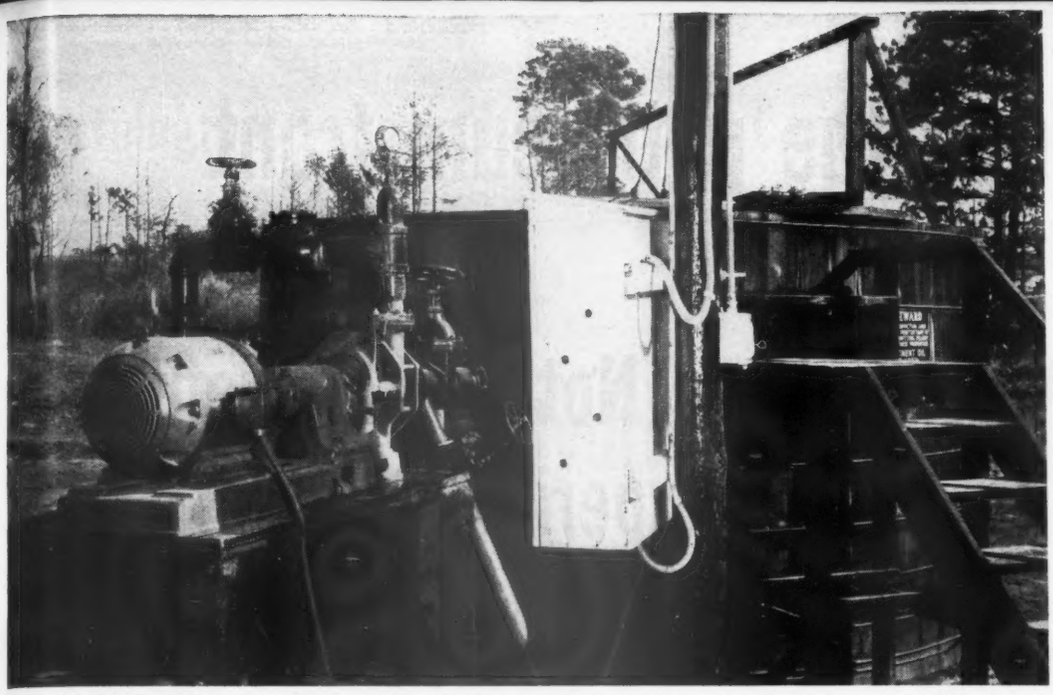
FIG. 12. Capital formation in the Venezuelan oil industry compared with that for the United States oil industry for the six-year period, 1943-1948, as represented by the source and disposition of capital funds. Similarities between respective segments indicate operation of like principles.



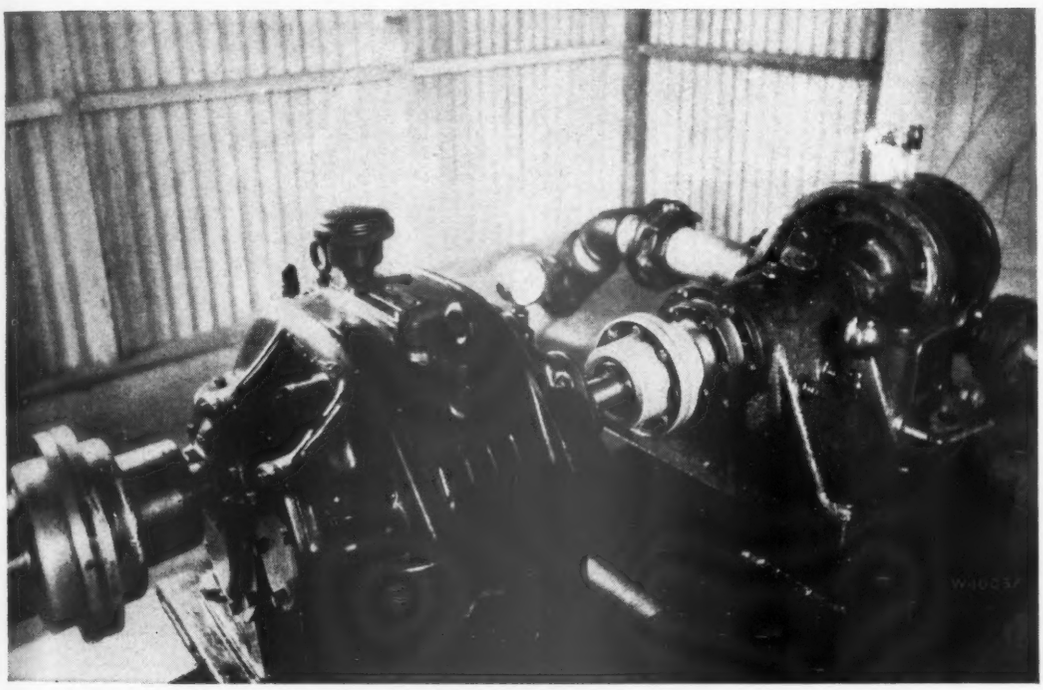
Standards for Policy

Policy is a controversial subject because the various interests are apt to have different points of view. These divergencies, however, relate largely to means rather than ends, since nearly everyone can agree on ultimate objectives—national welfare, advancing living standards, and progress. As to means, the main difficulty lies in the standards for judgment. These standards are apt to be based upon the urgencies of special interests and therefore are not well suited for sound decisions. If, however, economic criteria can be established, tests are afforded for determining the policies most likely to lead to the desired objectives.

There are five parties of interest in the oil policy of Venezuela: the industry, the consumer, the investor, other nations, and above all Venezuela it-



CT Worthite pump, transfers salt water from nearby wells to treating plant. Note isolated location where pump gets only occasional servicing



2½ HBLC-5 Worthite pump handling 5500 barrels of salt water a day at Magnolia Petroleum Co., Talco, Texas

Worthite Licks Salt Problem

In disposing of the salt water that is produced with oil from some of the older production fields, the cost of maintaining transfer and injection pumps made of iron, steel and bronze has been very high.

Since pumping stations in a large field are located over many square miles, a large crew of men is needed for frequent inspection and maintenance. But when Worthite gathering or transfer pumps are installed in these inaccessible places, they need *no* attention for long periods of time because *there is no corrosion.*

The photograph shows a Worthite 2-stage centrifugal pump on salt water injection service, installed by Magnolia Petroleum Co. in 1941 in their East Texas Talco field. No repairs have been required in eight years of operation. Only occasional packing and lubrication have been needed.

Also shown is a CT Worthite pump which transfers salt water from nearby wells to the treating plant. Note that this pump can be located in an isolated section because only occasional servicing is needed.

Casing, impeller and ring are cast in Worthite—a Worthington complex alloy containing 52% of alloying elements—Ni, Cr, Mo, Cu, Si, Mn.

NEWS

FROM THE PETROLEUM FRONT

AS REPORTED BY THE DEVELOPMENT ENGINEERS, FIELD SERVICE REPRESENTATIVES AND CUSTOMERS OF WORTHINGTON

NEWS from the petroleum front

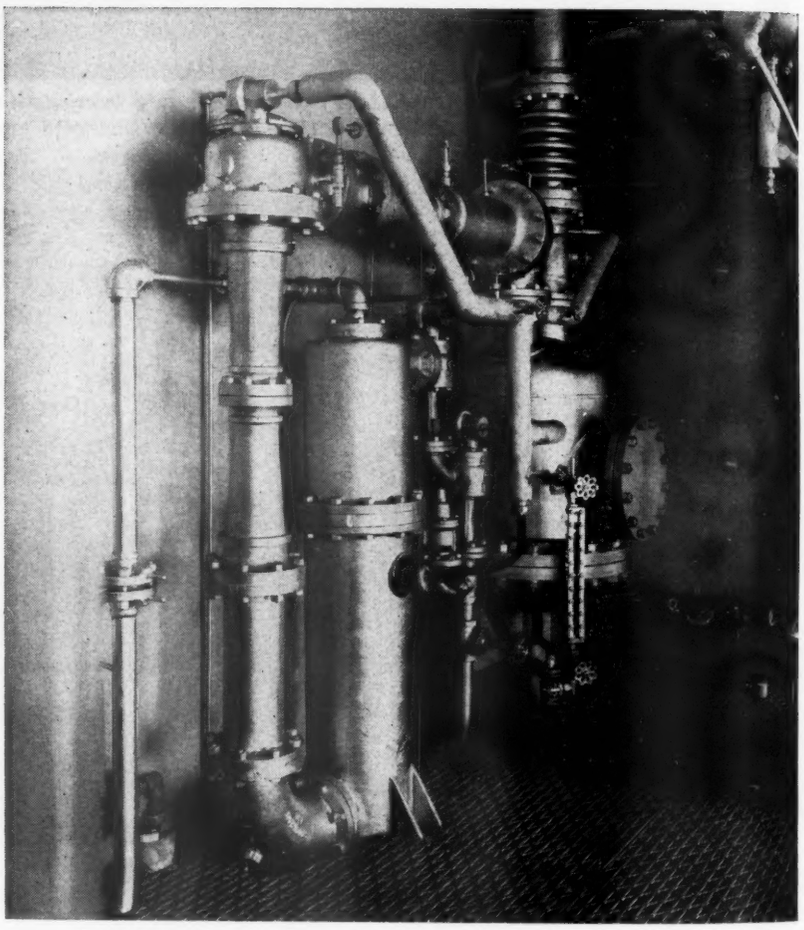
Worthington's Nothing Is Plenty To Shell's Experimental Work

How Worthington's Steam-Jet Ejector's Unusual Vacuum Characteristics Help Shell's Research Program

Creating an unusually high vacuum is the important part a Worthington 6" RPD steam-jet ejector plays in the research program on basic petroleum products, conducted at Shell Oil Co.'s experimental laboratory at the Martinez, Calif. refinery.

Serving a batch lube oil still, the ejector, single element, four stage with barometric inter-condenser between 2nd and 3rd stages, has a first stage which is steam-jacketed to prevent freezing within the stage. The inter-condenser is of the low-level type drained by a motor-driven centrifugal tail pump. Automatic controls are used to prevent flash backs of steam and water to the still in the event of power failure.

The ejector was installed about 1 year ago and handles 14 lb per hour total mixture at 1 mm hg abs. suction pressure. The 14 lb per hour is made up of 2 lb per hour air, plus 12 lb per hour water vapor. This is equivalent to approximately 3200 cu ft per minute. The unit requires 243.5 lb per hour steam at 90 psi and 33 gpm water at 73 F.



Worthington Steam Ejector at Shell Oil Co.'s Martinez, Calif. refinery

Paraffin Distillate Chilling

The huge Baton Rouge, La. refinery of Esso Standard Oil Company has a daily crude oil run of about 240,000 barrels. Since its conception in 1909, the plant has processed more than one billion barrels of crude oil—a record only a few refineries in the world hold.

The plant now produces such major products as: synthetic rubber, alcohol, liquefied gases, chemical raw materials, motor and 100 octane gasoline, solvent naphthas, kerosene, distillate fuels, lubricating oils and greases, asphalts, paraffin waxes, petrolatums, and has been responsible for the development of many of the processes related to these and other products.

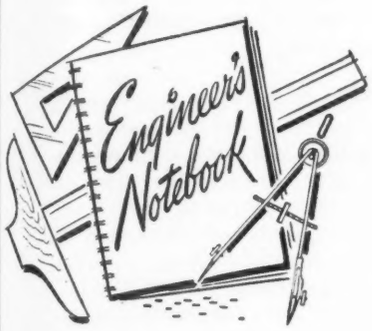
To increase its wax production, the refinery recently installed three Worthington double-pipe, scraped-surface, inclined* chilling machines and a complete ammonia refrigeration system using a 400 hp Worthington LTC-3 gas engine-driven ammonia compressor.

The charge stock-paraffin distillate, consisting of approximately 16% wax, is cooled in the inner pipes of the chilling machine. Spring loaded scrapers keep the inner pipes clean.

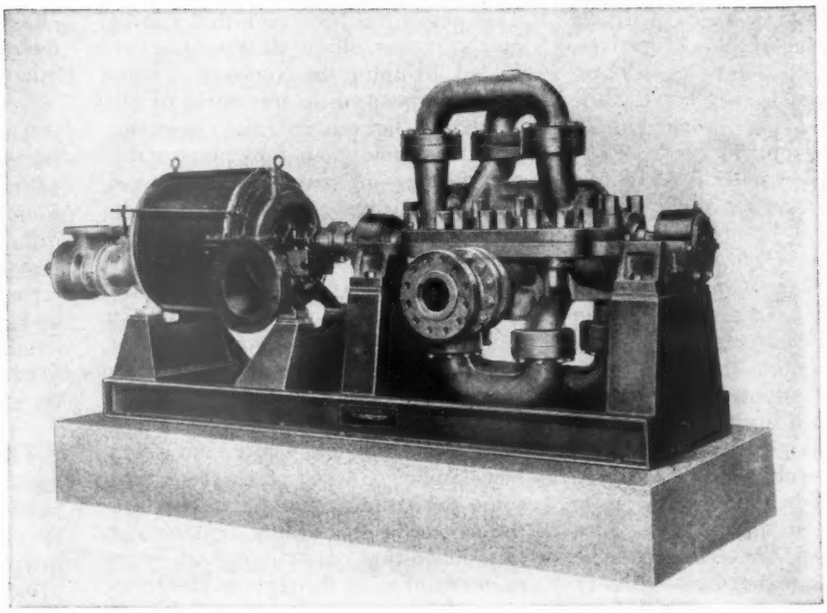
*Patented

Worthington Pump and Machinery Corporation
Harrison, N. J.

NEWS



Hydraulic Decoking



Worthington Turbine Driven High-Pressure Decoking Pump

Probably the most important recent improvement in the process of making coke is the hydraulic method of removing the coke from the coking drums.

Hydraulic coke removal and transportation is an efficient, inexpensive method, which eliminates the high cost, danger, and lost-time factors of hand labor, and delivers a premium grade of coke. This method was devised by the Shell Oil Company, and developed by Worthington Pump and Machinery Corporation and the Allen-Sherman-Hoff Company, to a point where the coke need never be seen until it reaches storage.

High impact-producing hydraulic jets bore a hole downward through the center of the coke bed. Following this, the cutting tool is used to remove the coke, which, falling with the water, drops into a sizing and feeder car that feeds coke of the proper size and quantity to a sump. From the sump, a hydroseal pump transports the mixture of coke and water to a coke pile or hydrobin. If the demand for coke is seasonal, a coke pile is used. In addition to serving as a storage place, the coke pile is also used to filter the water so it can be recirculated. Where space is limited and the coke must be shipped almost immediately, a hydrobin is incorporated in the system. The hydrobin is a large elevated bin, of conical construction, which separates the water from the coke, making it suitable for hauling within a few hours. Classification of the coke as to size can be made by the installation of screens on top of the hydrobin.

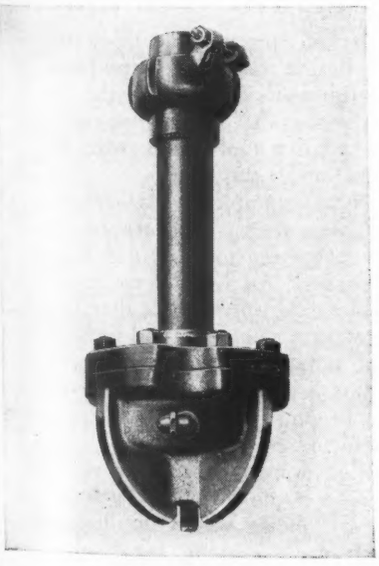
A third method of transportation and collection involves dropping the coke and water from the chambers directly into railroad gondolas. The water escapes through holes in the sides, and the coke is hauled to the coke pile and dumped or unloaded by means of a clamshell.

The advantages of hydraulic decoking are numerous. Due to the faster turn-around time possible with hydraulic decoking, the number of coking drums is reduced for a given plant capacity, thereby reducing the initial investment.

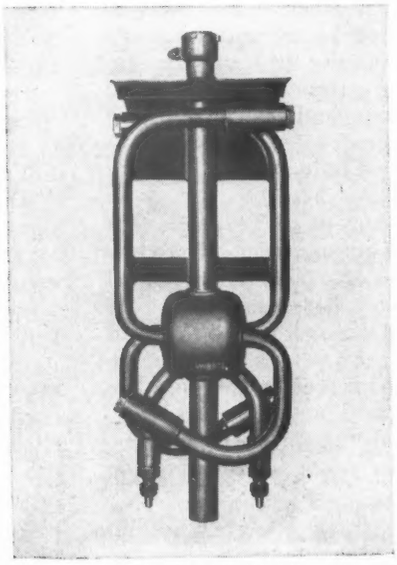
Hydraulic decoking is a labor-saving method. Three to seven men are required to operate the system during the cleanout period. Accident hazards are reduced, as men do not enter the drums. Dust hazard is eliminated, as coke is handled in a wet state. Maintenance costs are reduced.

Hydraulic decoking removes all the coke, completely eliminating loss in capacity. It also produces a coke free of contamination.

If further data is desired, please ask for bulletin WP-1099-B20C.



Boring Tool



Final Cutting Tool

self. We shall discuss each in turn, in an attempt to show the interrelationship of the five.

Each unit of the petroleum industry must conform to economic law of face extinction. Competition between these entities, as well as between alternate sources of supply, establishes this necessity as a policy for survival. Likewise there is every incentive for the industry to promote the welfare of Venezuela, to work toward the raising of living standards, to follow an enlightened social and labor policy, and to cooperate in every practical way with the Government. Any careful observer will find full evidence of wholehearted acceptance of these objectives.

The ultimate consumer of oil produced in Venezuela resides for the most part outside the boundaries of the State and beyond its control. The consumer is interested in only two things: an ample supply and a reasonable price. His policy, beyond question, is to buy the cheapest oil offered to him. It may be thought that the oil companies which convey Venezuelan oil to these distant consumers may exercise some choice between alternate sources of supply, and so they doubtless can to a limited degree and for a limited period; but these companies are inexorably forced by competition to cater to the consumer else they become derelict to the rules which control their existence. Thus the companies are not free, in ordinary times, to exercise a choice based upon other than economic considerations.

The investor, both corporate and individual, is the source of capital funds created through savings. National policies have a profound effect upon investor confidence and have much to say as to the geographic and industrial allocation of investor funds. Confidence is another name for credit which is essential to the transfer of capital from its sources to points of application. The investor's interest in the petroleum policy of Venezuela will wax or wane according to his interpretation of its effect upon the security and profitability of the funds which he has already invested there and those which he may contemplate for future investment.

Other nations have an interest in policy, both as consuming units and in respect to their national security. The United States, for example, doubtless looks forward to becoming an increasingly important consumer of Venezuelan oil, but it is the declared policy of the petroleum industry in the United States to welcome imports only as a supplement to domestic production, but not in such volume as to impair the economic health of the domestic producer.[18] It is also obvious that, in event of emergency, the United States will need augmented supplies of oil from Venezuela, and therefore it may be inferred that its policy will be that of encouraging all measures making for a healthy oil industry in Venezuela, the growth of its productive facilities, and its economic progress in general. In any event, the friendly relations always existent between the two countries would doubtless insure this attitude.

It is the policy of Venezuela itself, however, which will have the most to say about the future of Venezuelan oil and its bearing upon the economy. This policy has been such that a large and vigorous oil production has unfolded, bringing the Nation to a commanding position in the world of oil. It should be remembered, however, that this development took place under the impact of extraordinary, and partly transient, economic forces. Venezuela has benefited from the enlarged demands of the war and its aftermath and from the repressive policies followed by several countries which thereby retired from the field of competition in promoting the search for and development of oil.

To the close observer it appears that Venezuelan oil policy in recent years has displayed a regressive aspect in some particulars, doubtless reflecting the existence of a sellers' market and the difficulties of bringing about a greater diffusion throughout the economy of the economic energy inherent in oil. In consequence, trends were established which may weaken the competitive position of Venezuelan oil in world markets, while the national benefits inherent in a large oil production have been dissipated to an unnecessary degree in a rise in living costs and real estate values. Both factors are correctible and doubtless will be considered by the newly appointed Committee on National Oil Policy.

If a foreign observer may be permitted additional comments, we would venture to appraise the economic consequences of certain measures and at the same time outline a pattern of achieving some of the desired objectives not yet fully attained.

1.

The requirement of Venezuela that a portion of the national oil production in excess of local needs be refined in the country has resulted in very large capital expenditures at inflated costs which may weaken the competitive position of Venezuelan oil. The products turned out will have difficulty in competing in world markets, and this may result in lessening the value of the raw material and reducing the royalty revenue to the State. Moreover, an increasing number of consuming nations are requiring that oil be refined within their own borders, so demand is tending to take the form of crude oil requirements, not that of products.

2.

The action of the State in removing new concessions from the market in 1946 at a time when the demand for them was great has had the effect of diverting some exploration effort from Venezuela to other countries, such as Canada and the Middle East, with the effect of transferring part of the potential market for Venezuelan oil to other sources of supply.

3.

The labor policy of the State, while advantageous from the point of view of rapid social advancement for a limited group, has raised the wage differential between the oil worker and other workers so rapidly, has increased operating costs so sharply, and above all has so augmented the capital cost of expanding the labor force, that future growth is bound to be handicapped.

4.

The "50-50" theory of oil taxation was inaugurated in an inflationary period when net income was overstated, has evolved beyond its original intent by coming to disregard the principle of averaging, makes inroads on capital as well as income, and exerts a repressive effect upon capital formation as a result not only of its specific incidence but of its implications as well. Its flaws will become more apparent in the period of competition now being entered and it may be queried whether its continued application will turn out to be to the best interests of the Nation. For the past six years royalties accruing to the Government have exceeded by 21 per cent the dividends paid out by the Venezuelan oil companies, while total taxes, including royalties, have been over 2.5 times dividends. The theory of equal division of "profits" has come to be one of disequalization, without full realization of the fact.

These four examples will serve to illustrate measures which are likely to prove restrictive to sustained economic progress. All have elements of immediate social appeal. But they invade the stream of capital and impair its normal flow, with the effect of creating "shorts" in the circuit. They accordingly become obstacles to the most effective formation of capital.

To the economist it is perhaps of greater interest, however, to contemplate those policies which might set in motion *forces* making for funda-

18. See *A National Oil Policy for the United States*, submitted to the Secretary of the Interior by the National Petroleum Council, January 13, 1949, page 19.

mental improvements in the economy. Such measures can only be outlined in the broadest terms. The two prime objectives are: to keep Venezuelan oil competitive in world markets and to promote the transfer of the economic energy of oil to the whole economy. This first objective calls for restraint, even reversal, in taxation and other measures having the effect of raising operating and investment costs. The second objective requires measures designed to lower the cost of living and to stimulate domestic food production. These ends may be promoted by the direction of government expenditures more fully into roads, agricultural schools, ports, and waterways; by the stimulation of farm mechanization and facilities for the distribution of farm products; and by reduction in tariffs, simplification of trade procedures, taxation of idle lands to bring them into use, elimination of monopolistic practices in pricing, and the advancement of competition in fields where profit margins are highest. Furthermore, by giving confidence to capital through its treatment of existing industries, the State can point the way to the development of that vast unexplored area south of the Orinoco River whose geologic complexion is so similar to the Precambrian Shield of Canada as to suggest the presence of comparable mineral wealth. (See Fig. 1 again.)

Conclusion

We have attempted to outline the mechanism of a large-scale industrial activity and its impact upon the economy of an interesting country. The setting for this case study is unique, for nowhere else in the world are the factors of oil production and the welfare of an important nation so fully related, with the economy at the same time so clear of other elements of conflicting influence.

Venezuela has a favored resource which has enjoyed a rapid and effective development. It has accordingly proven to be more convenient to concentrate upon the production of oil and to exchange it for other goods than to produce these goods directly. This dependence upon oil, however, renders the Nation vulnerable to the fluctuations of a single commodity in world markets. The country, therefore, is faced with the need for investing prudently a portion of her current export proceeds in developing the most promising alternate resources and industries. In so doing, however, caution is required, for an excessive rate of investment or too great a concentration in its application is inflationary, which tends to nullify the effort.

Since the oil industry is the major source of Venezuela's income, it is also the principal source of investment funds. These proceeds are of two kinds. First, a large portion of the oil industry's income is used for maintaining existing plant facilities and for making additional investments in oil operations. Second, a further portion is returned to Venezuela, not in the form of direct investment, but as payments to the Government and to the industry's employees. Though these funds may be spent largely on consumption, it would be desirable to devote a greater share of them to the provision of productive goods and services.

Investments, however, are undertaken in search of a profit commensurate with the risk and the effort. And since the oil industry is the main source of Venezuela's investible funds, it follows that the country's outlook for economic development depends to a large extent upon the preservation of a reasonable profit outlook for the oil industry. The size of the total income stream is linked very intimately with the outlook for a small portion of it, net income. Consequently, the pace at which Venezuela can progress is related very closely to this factor, since it is oil income that provides the industry's investment, thereby generating more oil revenue, and it is also oil income that contributes and attracts the bulk of the funds available for investment in other fields.

Now that the world has become more amply endowed with oil, the problem of maintaining markets becomes more acute and is commingled with that of promoting the economy. In consequence, progress requires constant and unremitting emphasis on the dual objectives of holding the customer and "sowing" the oil. These maxims offer the framework into which specific measures may be fitted and their effectiveness anticipated. The consumer may be served by keeping costs down to meet competitive world levels so that the demand for Venezuelan oil may be sustained and expanded. The oil may be "planted" by the continued investment of capital in oil exploration and production together with the development of means for furthering investments in other productive activities which in turn are creative of new wealth.

The whole process calls for the maintenance of an energy circuit in which ineffectual diversions are avoided, the utilization of capital for current consumption is minimized, and the processes of capital formation, both within the industry and throughout the economy, are nurtured and encouraged. * * *

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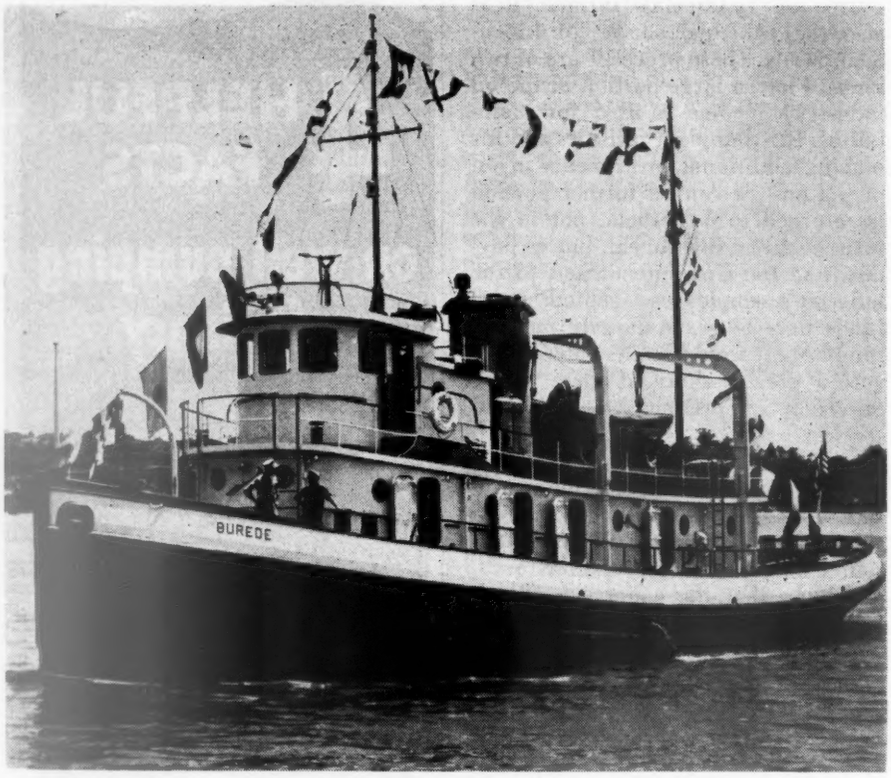


The *Burede* during her trial runs, one of three tugs delivered to the Shell Caribbean Petroleum Company for use in Lake Maracaibo, Venezuela. Tugs were built by Gulfport Shipbuilding and Dry Dock Corporation of Port Arthur, Texas.

Maracaibo Tugs

THREE new diesel-driven tugs have been delivered to the Shell Caribbean Petroleum Company for use in that company's operations in Lake Maracaibo, Venezuela.

These tugs will be used to tow general cargo barges ranging from 100 to 600 tons carrying capacity, oil carrying barges up to 800 tons, floating cranes, drilling barges, dredgers, and other miscellaneous floating equipment in Lake Maracaibo up to distances as far as 120 km from base. In addition, they will be called on to make occasional towing trips to the neighboring islands of Aruba and Curacao.

Lake Maracaibo has a tidal outlet to the sea and is approximately 120 miles long by 60 miles at the widest part. It is subject to sudden storms with strong winds, so that boats serving the industry must be extremely powerful and seaworthy. For this reason diesel-powered tugs were decided upon.

Orders for the three new tugs were placed early this year. The first of these craft, the *Onoto*, was delivered to her owners on April 30; the *Burede*, the second tug, was delivered May 31; and the *Pemeno* was accepted by Shell on June 30 and arrived in Maracaibo on July 11. All three tugs were built by the Gulfport Shipbuilding and Dry Dock Corporation of Port Arthur, Texas, and made the trip through the Gulf of Mexico to Venezuela under their own power.

Each of the tugs has the following dimensions:

Length, O.A.	102 ft 2 in.
Beam, M.D.	24 ft 0 in.
Depth, M.D.	12 ft 4 in.
Draft, M.D.	10 ft 1 in.

They are of welded steel construction to American Bureau of Shipping Classification, and were built under the supervision of J. T. Bothoff, representing the owners at the shipyard.

Each tug is powered with a General Motors 12-cylinder, 2-cycle Model 12-278A diesel engine, rated 1200 bhp at 750 rpm and driving the propeller through a reverse-reduction gear unit. This engine and the higher-powered Model 16-278A unit are installed in hundreds of sea-going and inland waterways towing vessels, and are highly regarded by their owners as exceptionally reliable and economical power producers. Auxiliary power in each tug is supplied by two General Motors Model 3-71 30-kw diesel generator sets.

The main propulsion engine is fully controlled from the pilot house and the after end of the boat deck through electric control of the air valves to the airflex clutch. A new fool-proof automatic timing device makes it impossible to inflate the astern clutch before the ahead clutch is deflated and vice-versa. On trials, the *Onoto* made a speed of 11.6 knots with engine turning 750 rpm and the 8 ft 6 in. by 5 ft 6 in. three-blade propeller turning 212 rpm.

A new feature of the vessels is the 400 gpm fire pump driven through the airflex and reduction gear from the forward end of the starboard 30 kw diesel generator set. This fire pump furnished water at 145 lb pressure to fire-hose connections port and starboard on the boat deck and main deck and to the fire monitor on the wheel house. The hose connections and monitor can also be fed through a complete dual-foam proportioning tank.

Owing to the large crew necessary for operation in South America, each vessel has accommodations for 20 people, including one engineer apprentice, with combined galley and mess. Galley equipment includes a 20 cu ft deep-freeze box and a 20 cu ft day box with ice-making trays and cold water faucet. Oscillating fans are installed in all quarters and galley, and a 1½ hp blower exhausts air from the engine room. Accommodations also include separate toilets and showers for officers and seamen, and the captain's quarter has a private toilet and lavatory. All staterooms are provided with lavatory and shaving cabinet.

Deck equipment consists of electric full follow-up steering, 12½ hp capstan aft, and anchor windlass forward. The 12-person lifeboat on each tug is of the square-stern type, powered with an inboard motor, and built of aluminum, and is also used as a tender when the tug is operated off shallow river mouths, etc.

The tugs are equipped with ship-to-shore radio having adequate range to keep in touch with Maracaibo at all times. ***

20,000-Ft Drilling Problems

ALTHOUGH not much commercial petroleum production has yet been reported below 15,000 ft, a dry wildcat well in Wyoming was drilled to a new world record depth of 20,521 ft on June 18, 1949. This record marks an outstanding engineering achievement by the operator and the manufacturers of the drilling equipment and points the way toward further prospecting below 15,000 ft. Less than 30 wells have penetrated that depth, however, because of the high costs and risks involved.

As operators, including geologists and engineers, believe that hundreds of rich oil and gas fields may be found between 15,000 and 20,000 ft (and deeper), the necessity becomes more urgent for reducing deep drilling costs so as to make such operations economically feasible. An interesting paper on the problem was presented at the recent API convention in Chicago. It was the result of a 6-month review of equipment and techniques now used for deep drilling. More than 150 representatives of the users and suppliers of oil-field equipment participated in 16 meetings concerning 20,000-ft drilling problems.

The study was divided into four main topics: tubular goods; prime movers and hoists; pumps, bits, and blowout preventers; and techniques. Eight co-chairmen, including a user and a supplier for each main topic, presided over the meetings. They were responsible for developing the interesting information contained in the paper. The object of the study was not necessarily to solve all the problems connected with deep drilling but, rather, to find out what problems existed and refer them to specialists in the respective field for detailed study and development.

The results indicated that some of the present methods and equipment are suitable for 20,000-ft drilling operations. It was found, however, that a large number of problems should be given careful consideration before such a drilling program is attempted.

Joint studies such as this coupled with data from actual deep drilling experiences in various areas should be of great value to the industry's effort to discover and develop 20,000-ft fields.

K Marshall Fagin

YES!

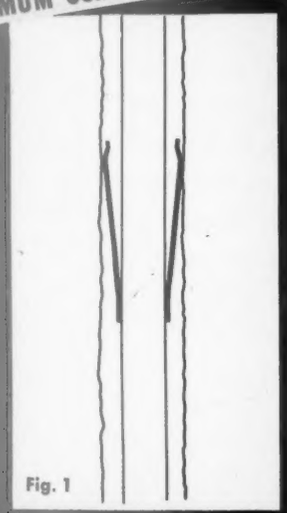


FIG. 1—Running in casing or liner equipped with a Baker Metal Petal Basket. Minimum safe annular clearances are sufficient for safe passage of the basket assembly.

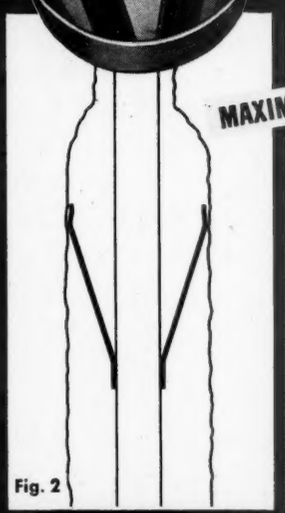


FIG. 2—Basket expanded in hole which has been "bottlenecked" by using a Baker Rotary Wall Scraper. The expansion range of the overlapping "Petals" permits such special cementing.

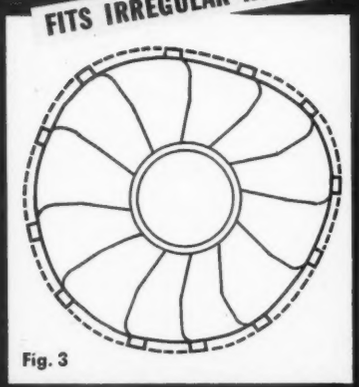


FIG. 3—The flexible Metal Petal Basket readily expands to contact the entire circumference of holes of irregular shape, and forms a strong, one-way packer which prevents downward movement of the cement slurry.

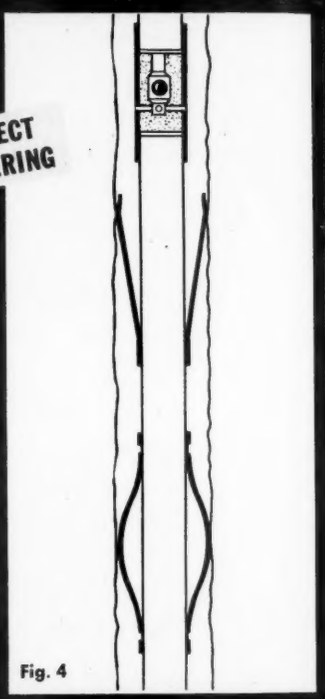


FIG. 4—Maximum efficiency of the Baker Metal Petal Basket is assured when a Baker Model "G" Casing Centralizer is used to secure a uniform annulus in which the Basket may expand.

FOR any cementing problem where a lower zone must be protected from contamination by the cement slurry (as well as from sloughings or cavings) the Baker METAL PETAL Basket will be found both safe and successful.

The unit is constructed of a number of individual "petals" made of flexible sheet metal. These petals are mounted on reinforcing spring steel ribs, which in turn are mounted on a ring to form the Basket. The all-metal construction and design provide ample strength; lessen the possibility of splitting or otherwise damaging the Basket while it is being run in the well; and the metals used are unaffected by the usual acids employed for various purposes.

When running in the hole, the upward pressure of the fluid tends to close the "petals" thus providing fluid passageway between the Basket and the walls of the hole, without distortion of the Basket. As soon as the casing comes to rest, upward pressure by the fluid is relieved and the petals expand to contact the walls of the hole. Any tendency of the fluid to move downward then presses the flexible petals more firmly against the entire circumference of the hole. Solids which are strained from the fluid tend to build a bridge inside the Basket which is thus converted into a one-way packer of great strength and effectiveness.

The "Metal Petals" not only expand to contact the entire circumference of large-diameter holes, but also pack-off in holes of irregular shape; and the independent action of the individually mounted, overlapping petals permits successful use of the Basket in casing programs with minimum clearances.

MOUNTINGS MEET ALL NEEDS

The Baker Metal Petal Basket is furnished as a separate unit for installation in the field on the customer's casing, either as a fixed unit or as a slidable unit (with the use of stop rings). When desired, the Baker Metal Petal Basket can be furnished affixed slidably or stationary on a plain or perforated nipple to meet the requirements of the cementing job to be performed.

For details see the BAKER (or Composite) CATALOG; or ask any Baker representative for specific recommendations on your cementing problems.

Sentinel Hill Core Test No. 1, looking southwest.

Petroleum Exploration in Arctic Alaska

W. G. GREENMAN*

ALTHOUGH the Arctic coastal plain of Alaska was recognized by the United States Geological Survey as a prospective oil-producing territory as early as 1904, it was not given serious consideration until 1922, when certain companies in the petroleum industry sent parties to Point Barrow to stake oil prospecting claims. These claims were not validated, however, and the area now known as Naval Petroleum Reserve No. 4 was carved out of this coastal plain by President Harding in 1923 through an executive order (see map).

During the next three years, USGS field parties with funds provided by the United States Navy, accomplished considerable geological reconnaissance work in the area. Short working seasons, lack of modern methods of communications and transportation, indifferent logistic support, and lack of interest, however, brought the work to an end.

At the beginning of the "Campaign in the Pacific" phase of World War II, there arose grave doubts in the minds of responsible government officials concerning the availability of sufficient petroleum products to maintain the planned tempo of operations in the Pacific Theater. This situation was aggravated particularly on the West Coast where a declining supply from California fields was causing a serious oil shortage.

This shortage, together with relatively difficult transportation facilities across the mountains from the East, revived the Navy's interest in the petroleum possibilities of Naval Petroleum Reserve No. 4. Funds were again made available by the Navy to resume the work of exploration. The project began with an airborne geological reconnaissance party in the spring of 1944, and continued to expand until now it consists of a full-scale exploration organization.

EXCLUSIVE

The plan of exploration follows the usual pattern of foreign exploration by the petroleum industry; namely: Reconnaissance by airborne magnetometer; aerial photography for geographical mapping and geological studies; geological surface mapping; subsurface reconnaissance by gravimeter, seismograph, and core drilling; and finally, the drilling of test wells on carefully selected locations. In addition, a preliminary pipeline survey was planned to determine the volume of reserve and productive capacity that should be found to support economically the installation of expensive transportation facilities required to deliver the oil to West Coast refineries by way of ice-free ports in southwestern Alaska.

Seabees Preceded Contract Operation

Throughout the war, the work of exploration was undertaken by a United States Navy Seabee detachment, which pioneered the way to the

*Commodore, U.S. Navy, and director, Naval Petroleum Reserves.

solution of most of the problems imposed by the Arctic. The officers and men of this organization were carefully chosen for their specialized knowledge of petroleum exploration and production as well as for their experience in cold weather amphibious operations. At the close of the war, the Seabee unit was disbanded and the Navy employed commercial contractors experienced in foreign oil exploration, Arctic construction, and transportation. These contractors are continuing the work with all the skill and experience that private enterprise has developed in the exploration for oil both at home and abroad.

The normal problems to be expected in an exploration of the magnitude of this undertaking were increased many fold by handicaps imposed by nature in the far North, and lack of satisfactory patterns and precedents that could be used as guides in meeting them. This made it necessary to proceed slowly and with caution until the ingenuity and perseverance of those in charge of the operations obtained satisfactory solutions.

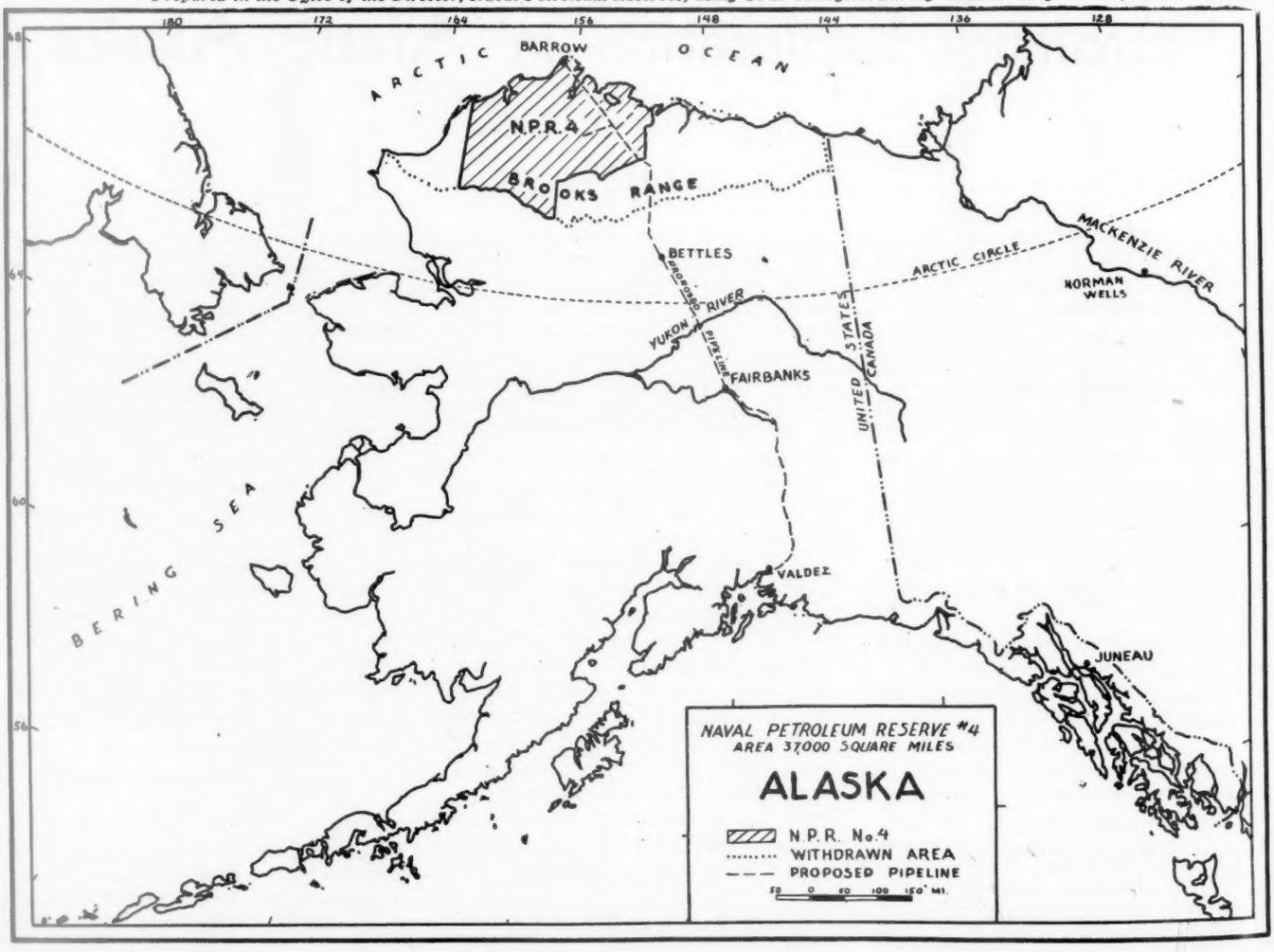
Aerial Photography

The first and most important requirement in getting the exploration under way was the preparation of accurate charts of the Arctic coastline and maps of the interior adjacent thereto. The first waterborne supply expedition to Point Barrow in the summer of 1944 reached its destination with virtually no charts of the coastal area, and the first overland party to work in the Reserve that year was provided with maps which were in error by many miles. The United States Coast and Geodetic Survey has been actively engaged, since the summer of 1945, in preparing accurate charts of the Arctic coastline east and southwest from Barrow. Aerial photography of the interior of Arctic Alaska begun by the Army Air Force in 1943 and since continued by the United States Navy has provided the USGS with the necessary photographic information for the preparation of reasonably accurate topographical maps of Arctic Alaska.

In planning the availability of supplies for the various phases of the exploration, heavy equipment and bulk stores had to be carried by ship because the cost of air transportation, the only other means of supply, was prohibitive. It was found that the one accessible landing area in the Reserve was on the beach at Point Barrow, the northernmost tip of Alaska, and that this beach was clear of ice for only a very short period in summer. Furthermore, the polar ice pack lies offshore only a few miles, during the short period when the beach is clear. A shift in wind may drive the ice back and endanger the ships lying offshore. Because of this situation, the landing of material at Barrow is accomplished each year by the United States Pacific Fleet as an amphibious training mis-

Map of Alaska showing location of Naval Petroleum Reserve No. 4, scene of the Navy's oil exploration in the Arctic. This reserve lies within an area (indicated by dotted line) north of the Brooks Range, which is withdrawn public land. The mineral rights are reserved under the jurisdiction of the Secretary of the Interior. Much of this area is prospective oil land.

Prepared in the Office of the Director, Naval Petroleum Reserves, using U. S. Geological Survey "Alaska" Map "A" 1947 Edition as base.



Drilling foreman at Simpson test well No. 1 makes a report by radio.

Food is unloaded from Wien plane from Umiat and cached, Point Barrow.

sion, and is planned and carried out in the same manner as were landing operations during the war.

Cargo must be well packaged and palletized where possible, in order to withstand the rough handling of unloading and to facilitate its movement to warehouses and out-of-the-way areas. The procedure adopted by the Navy Department as a result of war experience for handling cargo on an amphibious operation has proved excellent.

Due to conditions of terrain, it is impossible to move this equipment and supplies to operating areas in the interior until the coastal plain freezes solid in midwinter. Thus, planning and procurement of supplies and materials for any summer operation of the exploration must begin a year and a half ahead of the actual beginning of field work.

Subsoil Frozen Permanently

The ground surface of the Arctic plain is covered with Arctic tundra varying in thickness from 1 to 18 in. Beneath this cover the subsoil is frozen permanently to a depth of several hundred feet. The frozen material consists of silt, vegetable matter, conglomerate, and moisture in the form of ice lenses. During the winter months, the tundra is frozen solid and will support the weight of any vehicle or structure, but in summer the exposed surface thaws to form swamps and marshes that, with the numerous lakes and rivers, present a virtually impassible barrier to any kind of overland traffic. Below this, the permanently frozen ground, called "permafrost," presents many critical problems covering all phases of the exploration from construction to transportation.

Construction methods in the Arctic follow the general basic pattern used elsewhere but the complications usually encountered in ordinary climates are intensified because of the extreme cold and permanently frozen ground. The principal difficulties encountered are proper site locations, adequate foundations, planning for and movement of material, effective insulation of buildings, and obtaining men who have the stamina to work under unexpected difficulties and tribulations.

Transportation Problems

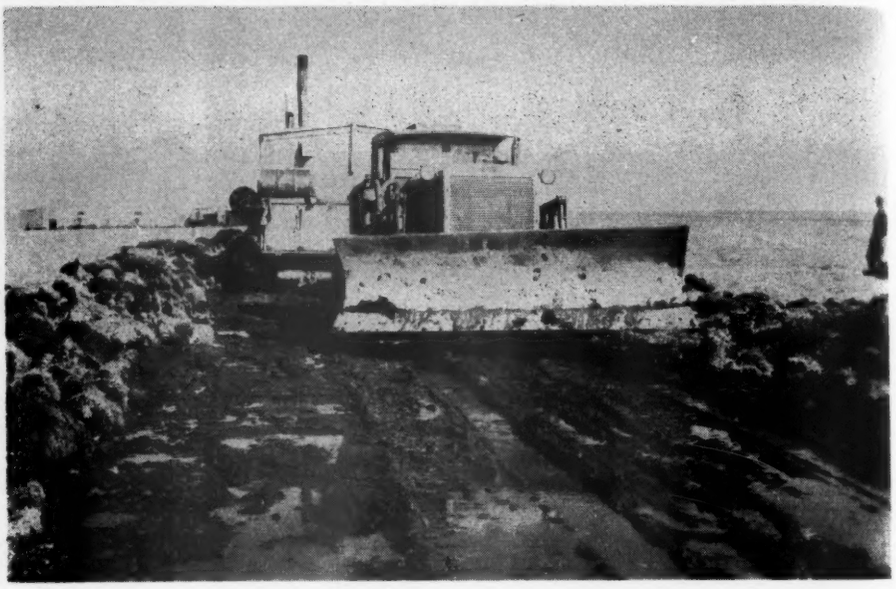
Land transportation problems are many and difficult because of the wide variation in temperatures and the changing ground conditions of the coastal plain from ice to swamp to ice with the seasons. All motorized equipment with the exception of the cater-

View of Base Camp Barrow, looking northeast.

pillar tractor have to be amphibious in design because of the numerous lakes and rivers that cannot be avoided. All motorized equipment must be track-driven to provide traction and for the maximum distribution of weight over the marshy ground; and all must be winterized for protection of engines and operating personnel against the extreme cold of winter. There are no ready guides for the solution of this problem and many experiments must be discarded before satisfactory results may be expected. Improper fuels and lubricants for Arctic use may cause many failures and the machinery itself may require some alterations before satisfactory operations are assured. In one instance the power unit of the LVT (Landing Vehicle, Track), the overland trucking vehicle of the exploration, had to be changed from gasoline to diesel to eliminate fire hazards on the trail, standardize equipment, and minimize the possibility of monoxide poisoning.

Combinations of terrain and weather and the absence of landmarks combined with poor visibility and discernibility, particularly in winter, make necessary some form of navigational aids in order to travel from one point to another. At these high latitudes, a compass is either useless in the regions immediately surrounding the magnetic pole or very erratic due to the weak horizontal component of the earth's magnetic field. For this reason, vehicular compasses are a particular problem.

The exploration has adopted the practical solution of marking the sled train routes by flags dropped from the air and by sending a scout ahead in a land vehicle to pick up the trail. To meet future needs, the Corps of Engineers, United States Army, and the Civil Engineer Corps, United States Navy, are studying the use of gyro-compasses and other navigational equipment including other electronic devices that may be adopted for use in land vehicles.



Tractor train moving seismograph party. Tundra was dozed off down to frozen ground only few hours previously.

Tractor Trains

In order properly to organize tractor trains for movement of heavy equipment in the sub-zero darkness and blizzards of mid-winter, it is necessary to experiment with sleds and sled-mounted wannigans until sled trains may be moved without mishap or be repaired en route and operating personnel may be properly housed and fed on the trail. These sled trains are hauled by heavy tractors* and movements are conducted without difficulty over the frozen Arctic plain in mid-winter for hundreds of miles hauling thousands of tons of equipment that must be cached in the winter months in preparation for the coming summer's work.

Because of the almost impassible conditions of the Arctic plain in summer and for quick movement in both winter and summer, the airplane is indispensable in support of all Arctic field operations and for the transport of urgent material and personnel from populated areas. The airplane does not require prepared roads. Its ability to operate in sub-zero weather is established. It may land on skis, floats or wheels on temporary runways without difficulty and may draw an ample fuel supply from established bases to permit it to carry out its mission without intermediate support.

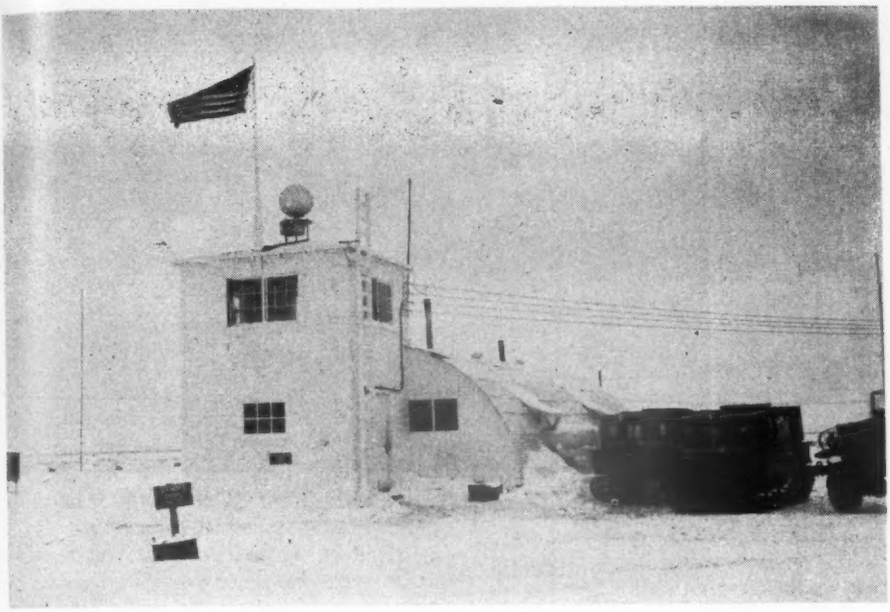
Caterpillar pulling load of pipe, Point Barrow.

Airplanes Used Extensively

The necessity of relying almost entirely on the airplane for movements of personnel and materials and supplies that cannot be anticipated in support of interior operations has made necessary the building of a landing field at the main base camp at Point Barrow and another at the secondary base camp at Umiat on the southeast edge of the Reserve.

These fields are capable of receiving two and four engine cargo planes

*D-8 caterpillar.



Umiat airstrip, tower, and radio building, looking southeast.

bringing in personnel and material from the outside, and furnish support bases for the small planes that maintain contact with the geological and geophysical field parties and the drilling camps. In winter, landing strips are prepared for the larger planes on the frozen tundra and lakes in the vicinity of field activities that permit fast movement of needed heavier and bulkier materials during that season of the year. The smaller planes can land almost anywhere on the coastal plain at any time of the year except during a short period in the spring when the ice is breaking up and again in the fall when ice is forming.

Notwithstanding the thought that has been given to the logistic support of field operations either by overland transport or by air, there are two periods of the year when logistic support fails almost completely. One is a short period in the spring when the ice is breaking up on the numerous lakes that dot the area, and the other is in the fall when the ice is forming and before the ground is thoroughly frozen. During these periods, it is dangerous for small planes to land. Furthermore, track-driven vehicles cannot find the traction to lift them from the surface of lakes with steep banks. The Bureau of Ships of the Navy Department is now designing track-driven vehicles for military use that will negotiate surfaces of varying densities and viscosities ranging from hard soils to salt and fresh water and snow and ice. The contours of the surfaces to be traversed range from zero slope to 45 deg, negative, positive, fore, aft, and lateral.

Climatic Factors Important

The wide variation in climatic conditions in the Reserve makes a study of climatic factors of first importance in connection with field operations. The principal factors are: Duration of daylight at various times of the year, variation in temperature, wind, precipitation, ceiling, visibility, and thickness of ice. These factors all have to be considered in the planning and carrying out of any field operation. As an aid in such planning, a work feasibility chart may be prepared by operating personnel for the purpose of indicating the type of work that may be accomplished under any combination of climatic conditions in that area.

Because of the isolation of camps and field parties from the main camp at Barrow, reliable voice radio communications are essential for continuous contact. The Navy Department supplies the necessary equipment and conducts essential experiments for improving this vital link. Contract personnel operate and maintain the numerous stations. In this connection magnetic influences have an adverse effect on radio wave propagation to the point where areas are completely blanked out for days. This phenomenon is being studied by the Army Signal Corps and the Bureau of Standards.

At the beginning of the exploration, it was evident that there was no adequate clothing in the stocks of the military services to meet the rigorous conditions imposed on men employed out of doors the year round in the Arctic. Consequently, those in charge of the exploration were forced to develop garments adequately to protect the personnel and at the same time permit freedom of movement under working conditions. The pattern of clothing thus developed is now being used by the Bureau of Supplies and Accounts to develop suitable clothing for Naval personnel operating in the far North.

Potable water is no problem anywhere in the area as the numerous lakes and rivers all contain fresh water and during the coldest period of the winter, some lakes are usually available that are not frozen to the bottom. In the event lakes are completely frozen in the vicinity of operations, ice or snow may always be melted.

Insect Control Necessary

Mosquitoes and other biting insects in swarms suddenly emerge in the arctic plain of the Reserve immediately following the spring thaw, and they persist until the first freeze in the fall. These insects are not known to be conveyors of disease, but they are extremely annoying because of their sting and the accompanying skin irritation. As the insect season coincides with the period of greatest human activity in the field, work is handicapped by the presence of these insect pests. Therefore, field studies leading to an insect control program were instituted in 1946 by the Bureau of Medicine and Surgery of the Navy Department which continued until the summer of 1949 when the Department of Agriculture took over the project. The program so far has been effective in isolating selected areas from insects, but there is still much to be accomplished. Any normal healthy male may become accustomed to Arctic conditions, but it must be recognized that living in an area of extreme cold with much darkness and no direct sunlight for long periods, together with the depressing effect of a monotonous terrain, few amusements, minimum comforts, and absence of family ties, require personal adjustment in any individual. Therefore, all personnel selected for Arctic work should be sound and healthy and free from respiratory diseases. Age within reasonable limits is not a deterrant. Diversions in the form of motion pictures, games, athletic events, and reasonably frequent leave periods are essential.

One of the greatest aids to morale in the Arctic is comfortable housing and well-prepared food. Both of these items have been given utmost attention by the Navy and its contractors, and it is believed that the high morale usually found throughout the personnel employed by the exploration is

Caterpillar pulling weasels on train.

Dozing road to beach at Skull Cliff.

due to the thoughtful planning that has been given these important factors.

Eskimos Employed

The Eskimo has made for himself an important place in the exploration and he is undoubtedly a potential source of manpower for future operations in northern areas. He has been found to be intelligent, active, and willing, and he has a natural mechanical ability that, by education and training, may be expanded to fill most any type of position requiring mechanical knowledge such as truck driving, tractor operations, engine overhaul, carpentry, radio operations, etc. The women are apt seamstresses, particularly with fur and leather.

Before full use can be made of this source of labor, however, the health and living conditions of the Eskimo must be improved. Due to many years of improper diet and most unsanitary living conditions, a large percentage are infected with tuberculosis either active or dormant. The Bureau of Indian Affairs of the Department of the Interior is taking active interest in improving these conditions and the money available to the Eskimo through employment by the Navy's oil exploration is also a great source of help.

Arctic Research

Other government agencies have found the Navy's base camp at Point Barrow a satisfactory location for Arctic research pursuits in many fields of science. Among these are:

(1) The Office of Naval Research at its Arctic Research Laboratory that sponsors:

(a) University contracts covering research in basic science particularly in biology, geology, and geophysics.

(b) Seismic Research sponsored by Naval Ordnance Laboratory.

(c) Coordinated permafrost studied by the Navy Department (Bureau of Yards and Docks) and the Department of the Interior (U. S. Geological Survey).

(d) Oceanographic program sponsored by the Navy Department —Hydrographic Office and the Naval Electronics Laboratory), the Woods Hole Biological Laboratory, and the Scripps Oceanographic Institute of the University of California.

(2) Magnetic Observatory sponsored and operated by U. S. Coast and Geodetic Survey.

(3) Arctic Test Station sponsored and operated by the Navy Department (Bureau of Yards and Docks).

(4) Aerological studies sponsored and operated by the Navy Department (Bureau of Aeronautics).

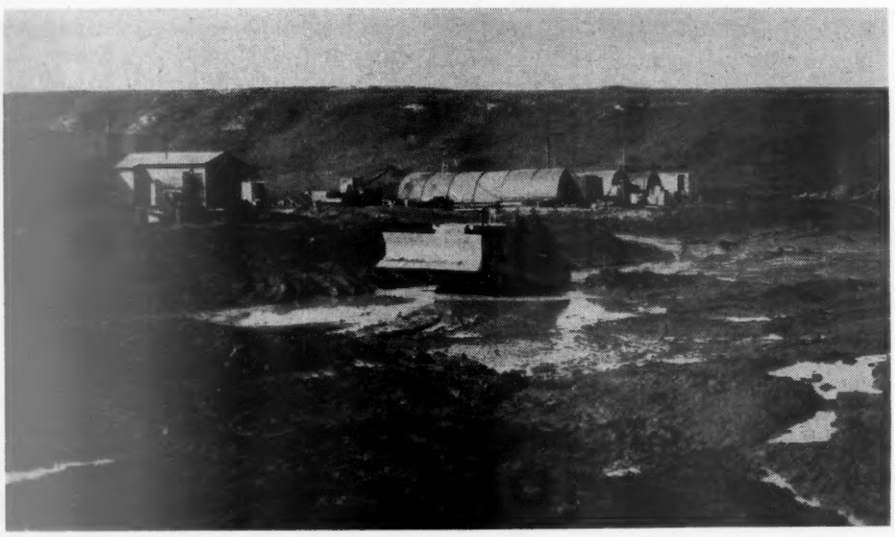
(5) Tests of Arctic clothing and material sponsored and operated by the Navy Department (Bureau of Supplies and Accounts).

(6) Radio propagation sponsored by the Signal Corps of the U. S. Army and operated jointly by the Signal Corps and the Bureau of Standards.

(7) Track-driven vehicle testing sponsored by the Navy Department (Bureau of Ships).

(8) Insect control sponsored by the Department of Agriculture. * * *

Camp at Umiat Test Well No. 2, looking northwest. Oil was discovered in a shallow well near this camp.



Natural Gas Flow at Supersonic Velocity

FLOYD K. BEACH*

AUTHORITIES on measurement of natural gas flows from large wells, in work done some 20 or more years ago, enunciated the principle that gas could be accelerated to a "critical" velocity equal to the velocity of sound and that efforts to push it faster only resulted in an increase in density. As early as May 1937, however, accounts were published of wind tunnels in which velocities in excess of sound had been attained. During the second great war research on aeronautical problems went forward at a much increased tempo, but much of the knowledge obtained remained on the secret list save for those who were making a special study of aeronautics.

Since the war considerable data have become available to the engineering profession in general, and it is clear that natural gas can be accelerated to velocities in the supersonic range. This paper does not present the results of any experimental work done by the writer, but it does try to reconcile the earlier notions with those now recognized, and to give just enough of the aeronautical background to enable the natural gas engineer to understand what to avoid.

The sequence of publications on measurement of natural gas at high velocity that have come to our attention, and the principles enunciated, is as follows. Numerical superscripts refer to the bibliography at the end of the paper, and a table of abbreviations used will be found there also.

Early Notions

In the 1927 edition of Natural Gas Handbook, J. C. Diehl quotes work of P. M. Biddison. Some 300 tests of gas flow through chokes resulted in the observation that when the upstream pressure is two or more times the downstream pressure, for a given choke, the flow is a direct function of the upstream pressure.

In 1928 Rawlins[1] showed that this principle can be applied to small orifices in general.

In 1929 Walter Reid[2] showed that when gas flows from an open pipe and a Pitot tube reading indicates an absolute pressure of two or more atmospheres, the flow is a direct function of the absolute pressure in the Pitot tube. He went further and showed that the rate of flow can be computed from side static measurements.

In 1935 Rawlins and Schellhardt[3] reviewed the above references and put them, with other relevant data, in a convenient handbook.

We gather from examination of Reid's work that he must have gone thoroughly into thermo-dynamic principles, for most of his conclusions are well supported. He died, we understand, as a fairly young man and had he lived he would doubtless have added much to the literature of the industry. Roland O. Cox[6] appears to have been associated with him, and Cox remarks, "The maximum or critical velocity that any gas can attain is equal to the velocity of sound in the gas." We cannot find our copy of Reid's paper[2] but we are under the impression that those were also his words.

Aerodynamic Notions

Green, Hiscocks, and Orr[8] reported at length on an examination they made of German aeronautical installations after the close of World War II, and stimulated us to inquire into artificially derived supersonic flows in air. The resulting exchange of correspondence with J. J. Green appeared in The Engineering Journal of March 1949.

A recent text by Liepmann and Puckett[4] contains sufficient material to enable the natural gas engineer to draw many conclusions. They show that when any gas flows through a throat (Fig. 1) and the speed approaching the throat is less than the speed of sound, there will be an increase in velocity as the cross-section decreases until the throat is reached. If the speed is still less than sound, *a*, the gas will decrease in velocity as the section increases. (Actually, as the natural gas engineer will recognize, the flow may continue for a space at about the same cross-section with eddies surrounding it, or if the throat is approached quickly, there may be a *vena contracta*. This condition is really aside from the general situation.) If, however, the velocity at the throat reaches the local speed of sound, a new set of conditions appears. Immediately the pipe widens or if it terminates, the velocity increases, and the increase is sudden, appearing as a shock wave.

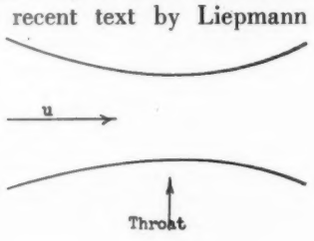


FIG. 1

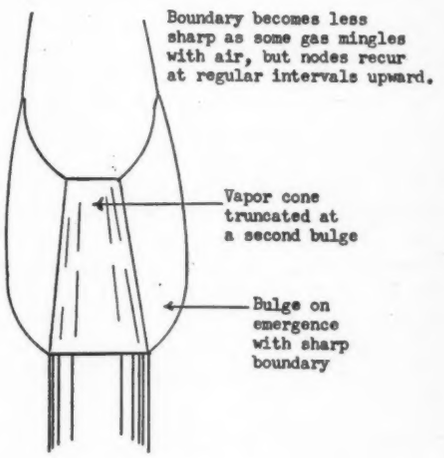

Boundary becomes less sharp as some gas mingles with air, but nodes recur at regular intervals upward.
Vapor cone truncated at a second bulge
Bulge on emergence with sharp boundary

FIG. 2

In Fig. 2 we reproduce a sketch made some years ago when witnessing the blowing of a gas well. The immediate bulge in cross-section of the emerging jet becomes an index to the fact that supersonic velocity has been reached. If we should now build a pipe with flaring cross-section and fit it to the existing pipe, we would have produced a supersonic tunnel along the line of wind tunnels that have been built for aeronautical research. If after extending the enlarged pipe for, say, 20 diam, we insert another throat of

*Engineer with the Petroleum and Natural Gas Conservation Board of Alberta, Canada.

EXCLUSIVE

suitable diameter, velocity might be checked to the speed of sound.

A throat, then, will mark a maximum velocity if gas at less than sonic velocity approaches and does not reach the local speed of sound. It marks a sudden increase in velocity if velocity reaches sonic at the throat. and it marks a check in velocity if supersonic velocity exists in the approaching gas.

If we look to temperature effects in the cycle from a throat that sets up supersonic velocity to the second throat that checks the velocity to sonic, we find that supersonic speed is attained at expense of temperature. In some recent wind tunnels, temperatures have been reached that are lower than liquid air, but on being checked so much apparent heat appears that cooling is needed at the throat. This leads to the observation that insertion of any obstacle in the path of the supersonic jet is sufficient to check a portion of the stream to stagnation velocity, with restoration of temperature. Insertion of a thermometer bulb would not give a true record of temperature in the stream *as felt by an observer moving with the stream*. We italicize the last statement, for it seems most important. There is doubt if a thermocouple built into the wall could record that temperature accurately. Measurement of electrical resistance in a small wire stretched across the stream is another device for estimating temperature, and it is subject to doubt because of its interference with flow.

Application to Measurements of Gas Flow

Having established that any gas can be accelerated to velocities in excess of sonic, it is desirable to examine existing formulas for gas measurement in the light of that fact. A liquid is sparingly compressible and when it moves through a channel of area A at an average velocity u, the rate of flow Q can be expressed

$$Q = Au$$

Gas is easily compressible and when it passes through a pipe it is necessary to use an additional factor ρ to express density. A convenient method is to call ρ the number of times unity needed to relate the effects of pressure and temperature at the section considered to the density at stated condition in store. The resulting equation for rate of flow becomes

$$Q = Au\rho \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

When gas issues from a throat, if we are sure that sonic velocity has been attained at the throat, A can be

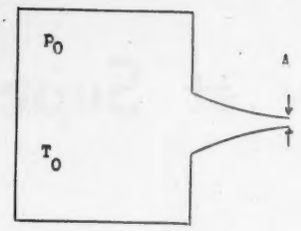


FIG. 3

measured, and if we can approximate temperature, T, and pressure, p, at the throat we can solve for Q. After our observations on the difficulty of observing T it will be realized that there are practical difficulties attending a high degree of accuracy, but an understanding of inter-related conditions should help.

Stagnation Conditions

Adopting the approach to the problem used by Liepmann and Puckett[4] in Fig. 3, taken from their text, the flow in any throat could be supposed to come from a near-by reservoir of stagnant gas at pressure p_0 and temperature T_0 and having density ρ_0. Assume that the gas flow at the throat reaches the local speed of sound a; that is, $u = a$. The temperature at the throat will be lower than T_0 since acceleration to velocity a is at the expense of heat.

It can be shown that $a = C\sqrt{T}$ in which C is a constant for a given gas. Hence as T declines, a also declines and any increase in u after passing the throat will be accompanied by a decrease in a. This leads to an observation that there is a critical value of a existing at the throat that we will write as $a.^*$ The co-existing values of p, T, and ρ will be written $p,^*$ $T,^*$ and $\rho.^*$

We adopt the usual abbreviations for specific heat at constant pressure, C_p, and at constant volume, C_v.

Then the ratio $C_p/C_v = \gamma$.

Various authorities on thermo-dynamics have arrived at the relations to be expected between stagnation and critical conditions. Assuming a perfect gas under adiabatic and isentropic flow,

$$\frac{p^*}{p_0} = \left(\frac{2}{\gamma+1}\right)^{\gamma/(\gamma-1)} \quad . \quad . \quad . \quad (2)$$

$$\frac{T^*}{T_0} = \frac{2}{\gamma+1} \quad . \quad . \quad . \quad . \quad . \quad (3)$$

γ for methane, the principle constituent of natural gas, is about 1.3 and substitution in these formulas says that

$$p^*/p_0 = 0.547 \quad . \quad . \quad . \quad . \quad (2a)$$

and

$$T^*/T_0 = 0.87 \quad . \quad . \quad . \quad . \quad (3a)$$

Liepmann and Puckett give a formula (2.17)[4] for sonic velocity in air and on adapting it to natural gas conditions

$$a = 60.96\sqrt{.60\gamma T/1.3G} \text{ ft per sec}$$
$$. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

or if $\gamma = 1.3$ and $G = 0.60$,

$$a = 60.96\sqrt{T} \quad . \quad . \quad . \quad . \quad (4a)$$

Conditions at a Choke

If a relatively small choke be inserted in a relatively large pipe and if the absolute downstream pressure be as small as 0.547 times the upstream pressure or smaller, we can be certain that the velocity in the choke equals $a,^*$ while the velocity just above the choke will be much lower. Hence, an observation of p and T just above the choke will approximate p_0 and T_0. Now on inserting the cross-sectional area of the choke as A in equation (1) with correction to square feet as a factor, and if we equate feet per second to thousands of feet per day, and equate ρ to terms of gas in store at 14.4 psi and 520 deg R. (equals 60 deg F), we find

$$Q = 1022\ A\ p^*/\sqrt{GT^*} = 802\ d^2\ p^*/\sqrt{GT^*} \quad . \quad . \quad . \quad (5)$$

Equation (5) is valid only for p^* and T^*, which are not observed above the choke, but equations (2a) and (3a) enable us to say

$$Q = 600\ A\ p_0/\sqrt{GT_0} = 472\ d^2\ p_0/\sqrt{GT_0} \quad . \quad . \quad . \quad (6)$$

But because we are not dealing with a perfect gas, as there may be heat transfer through the pipe and hence not a truly adiabatic operation, and as there is certainly some friction so that the operation is not truly isentropic, a factor must be introduced that brings theory to practise.

Loeffler and Dotterweich[5] show for a special flow bean, a series of factors obtained by experiment which they call the discharge coefficient, C_d. They start with a formula (revised to our symbols) that is close to our formula (6), but differing by less than 1 per cent,

$$Q = 605.37\ C_d\ A\ p_0/\sqrt{GT_0}$$

and using this formula, they find by experiment that C_d is about 0.83 for chokes of 1/4 in. or over, but dropping to about 0.76 at 1/8 in. As the greatest departure from isentropic flow is likely to arise from friction in the boundary layer, and supposing the boundary layer to be of like character in chokes of like smoothness, we would expect C_d to increase somewhat with diameter. They recognize this by showing that C_d has in general a value of a constant times the 2.0289 power of d.

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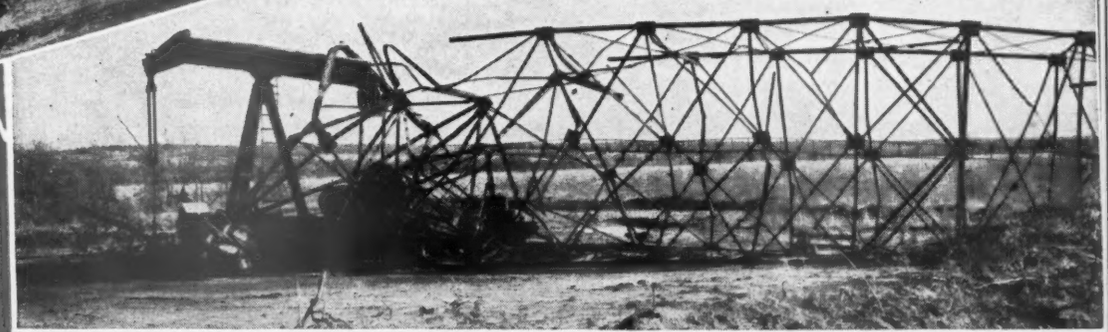

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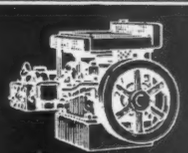

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Conditions Without a Choke

Sometimes a big flow of gas is encountered while drilling a well and it is desired to evaluate its rate of flow. A temporary pipe may be run to lead the gas outside the derrick floor, and the gas on emerging exhibits the characteristic bulge noted in Fig. 2. The engineer is usually equipped with a Pitot tube and manometer, and with a gauge that reads to 50 or 100 psi that can be substituted for the manometer. A 15-in. manometer filled with mercury will record up to about 7 psi and within that range or even a little higher a very fair accuracy of gas measurement is possible. When it is apparent that sonic velocity has been reached at the end of the pipe, he can be sure that a pressure gauge will be needed, for mercury will be blown from the manometer. What is more, the insertion of the Pitot tip in the jet will disturb the ordinary flow as it exists before insertion. This effect will be most noticeable for small pipe sizes.

A shock wave is to be expected, piling up on the upstream side of the tip, and the needle of the gauge will probably flutter over such a wide range as to make choice of reading uncertain. Having selected a reading believed to be fair, the pressure so read plus atmospheric pressure should be p_o, at least for the particular spot where the tip was held. A traverse across the jet will probably show that p_o varies, being greatest at the centre and decreasing toward the wall of the pipe. As for temperature observation, one is at a loss to observe it, and must make an estimation, bearing in mind the relation stated in equation (3a).

Thus, if T_o were 80 F (or 540 R) the temperature as felt by an observer moving with the stream would be 470 R or 10 F. Assuming that temperature condition and specific gravity of 0.60 from equation (6),

$$Q = 472\ C_d\ D^2\ p_o / \sqrt{.60 \times 540} = 26.2\ C_d\ d^2\ p_o$$

Walter Reid said, for an unstated T_o to hold the tip at the end of the pipe and in the center of the jet, when $Q = 23.81\ d^2\ p_o$ from which we find $C_d = 0.91$. Of course a variation in T_o would affect the value of C_d. His paper mentioned the use of 0.86 as a probable average value for C_d. He called the factor *E* or efficiency factor, but that is aside from the question. Considering that the tip usually obstructs the jet to some extent, his formula can stand.

Reid took an alternative method of measurement by observing the side static pressure and his routine was to measure the pressure four diameters from the end of the pipe. This usually means drilling a hole and tapping threads to take available equipment that can be connected either to the manometer or the gauge. The pressure observed plus atmospheric then becomes p^* and again some factor is needed to equate to mean pressure in the cross-section. Using equation (5) and again assuming $G = 0.60$ and $T^* = 470$ R we find $Q = 47.8\ C_d\ d^2\ p.^*$ Reid said $Q = 41.05\ d^2\ p^*$ and this gives C_d a value of 0.86.

If it were not for the interference of the tip when held in the jet, we would expect the coefficients in the two formulas to have the relation $p_o / p^* = 0.547$, whereas the relation is 0.58, but considering all uncertainties it seems wise to use Reid's formulas as he gave them, but to use side static pressure in preference to Pitot when the flow is large. Some persons may think that if the side static observed reading is small, there is lack of accuracy, but suppose there is doubt whether the side static reading is one psi or 2 psi. If the barometer is 14.4 psi, the doubt in the result is of the order of 6 per cent, or really ± 3 per cent.

Summing up, an accurately made choke, small in relation to the pipe, gives the greatest confidence in rate of flow, but it may restrict delivery from the well. A series of choke sizes used with increasing diameter will fix T_o and permit of extrapolation to open flow conditions. When chokes are not available or when other limitations are present, side static pressure readings are preferred, with Pitot tube measurement necessary if sonic velocity is not reached or if it is out of the question to tap the pipe for side static measurement.

Effect of Mixed Gas

Let us examine another factor and its effect on measurement.

Natural gas is usually composed predominantly of methane, but with some impurities. The impurities can be grouped into three categories. First, those having about the same γ as methane — hydrogen sulphide, carbon dioxide and water vapor. Second, those having a higher γ than methane — nitrogen at 1.4 and traces of argon and helium at about 1.67. Third, those having a lower γ such as ethane at about 1.22, propane at about 1.13, and perhaps higher hydrocarbons somewhat lower.

If in the mixture each constituent affects the overall γ in proportion to volume, a gas composed 50 per cent methane and 50 per cent nitrogen might have an effective γ of 1.35, while a gas 50 per cent methane and 50 per cent higher hydrocarbons might have an effective γ as low as 1.25.

Change in γ affects u (see equation 4) and it affects ρ through its effect on p^* and T^* but on differentiating we find that for $\gamma = 1.35$ we need a correction factor only a little over 1 per cent above unity; actually 1.0112, and for $\gamma = 1.25$ the factor is 0.9844. Uncertainties in T_o are likely to be so much greater that it is not worth while to bother with actual γ unless great accuracy is needed, and even then extraordinary refinements will be needed in $p,^*$ T^* or T_o and G determinations as well as in analysis of gas.

Effect of Deviation

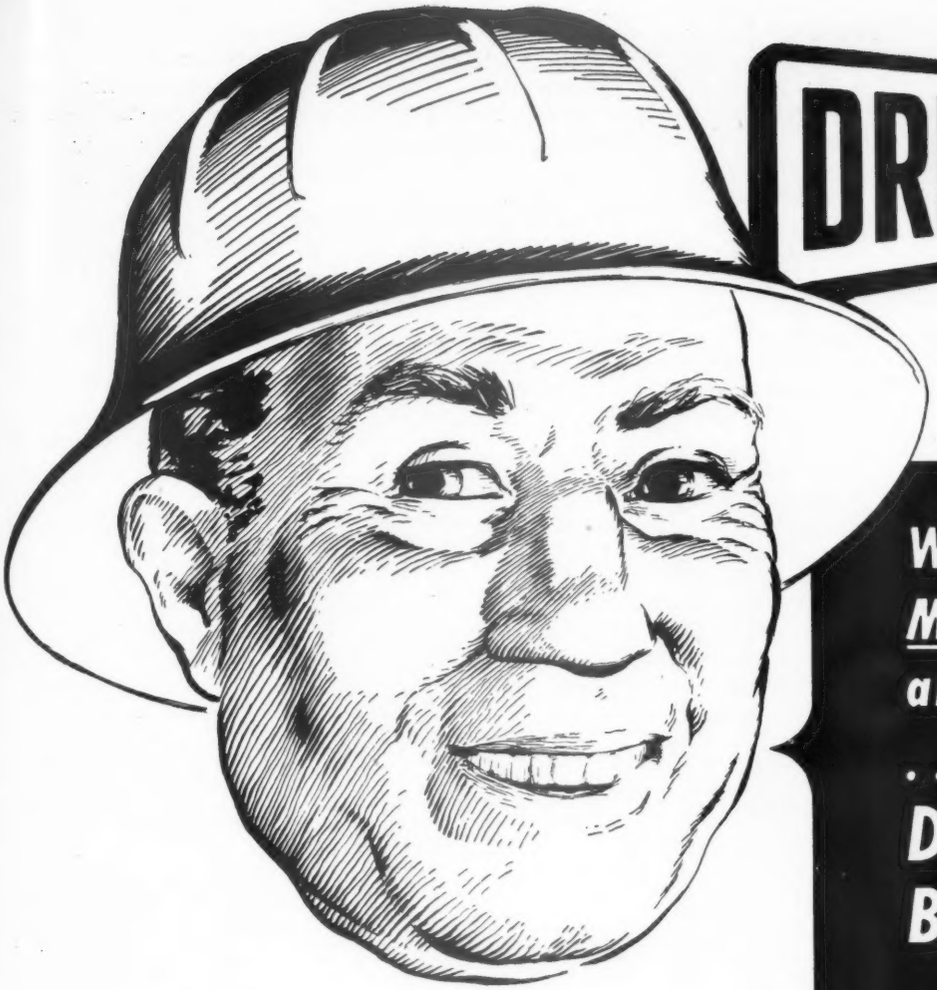
At low temperatures and high pressure gas deviates materially from Boyle's law. Such deviation affects ρ and by use of charts that have been prepared for compressibility factors and for the relation of pseudo critical temperature and pressure to gas gravity as given in numerous publications, among which are *The Petroleum Engineer's* Continuous Tables[7] under head-

Treatment Increases Production 500 Bbl Daily

By applying a "formation breakdown treatment" to 6 wells in its Horse Creek field in Wyoming, General Petroleum Corporation has increased the wells' yield by a total of 500 bbl of crude oil daily. Increases for individual wells ranged from 24 to 150 bbl per day. Average for the 6 was an increase of 58 bbl per day. Production from the six treated wells was 227 bbl per day before treatment, and 727 bbl per day after.

The "formation breakdown treatment" consists basically of pumping crude oil *into* (instead of *out of*) a well under extremely high pressures up to 2500 psi. Then the well is returned to normal pumping and the injected crude is removed. Increased daily production is generally gained after the injected crude is removed.

The Horse Creek field is believed to produce from underground fractures. General Petroleum production engineers believe the injected oil cleans existing fractures of mud and silt and possibly widens them. It may even create new fractures from which oil flows to the well.



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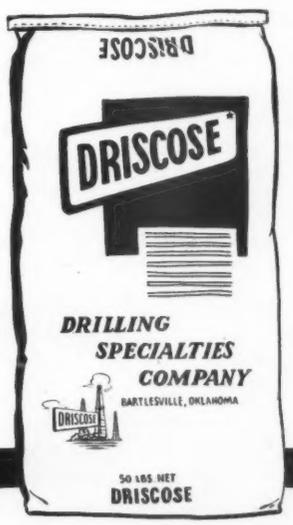

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ing 771 and 771.001, corrections can be made in ρ. It should also be noted that equations (2) and (3) were derived on the assumption that we are dealing with a perfect gas, and when there is noticeable supercompression they are not strictly true.

Supersonic Jet Conditions

Dr. J. J. Green[8] explains the peculiar appearance of the jet sketched in Fig. 2.

"In the case of efflux from a straight pipe in which there is no expanding cross-sectional area at the exit, however large the pressure drop between the gas in the pipe and the atmosphere, the pressure and velocity at the opening itself retain the values corresponding to sonic speed. The quantity of gas flowing out is quite independent of the pressure differential. Upon emergence from the pipe, however, the cross-sectional area of the jet will increase due to its internal pressure. Because of inertia effects the expansion of the jet will continue to such an extent that a region of reduced pressure is created in its interior. In the course of this expansion a supersonic velocity is attained.

As a result of the reduction of pressure within the jet, the flow will become convergent and the pressure will rise until it approximates to that at the pipe opening. From now on the process will be repeated. This explains briefly the succession of shock waves which have been observed in high velocity jets of air and gases."

Some observers of the series of nodes appearing in a jet from a large gas well have been inclined to say, "Count the nodes instead of trying to measure the pressure." Of course this is a fallacy, for the number of nodes that will be visible depends on so many factors of chance that it is not a valid criterion.

Symbols

Capital letters.

A = Area of cross-section, square inches,
C = coefficient,
C_d = discharge coefficient,
C_p = specific heat at constant pressure,
C_v = specific heat at constant volume,
F = degrees Fahrenheit,
R = degrees Rankine = F + 460,
G = specific gravity, air = 1.00,
M = 1000,
T = Temperature R,
Q = rate of flow, Mcf per day.

Lower case letters.

a = local speed of sound,
cf = cubic feet,
d = diameter, inches,
psi = pounds per square inch, absolute unless otherwise specified,
u = velocity, feet per second,
* = at critical speed of sound.

Subscript.

o = under stagnant conditions.

Greek letters.

γ = (gamma) . . . C_p / C_v,
ρ = (rho) . . . density.

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8. Green, Hiscocks and Orr, "Wartime Aeronautical Research and Development in Germany," The Engineering Journal, Oct.-Dec. 1948, and discussion by Green, J. J., and Beach, F. K., March 1949.

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P 094.8

How to Align Shafting Level and Straight Horizontally

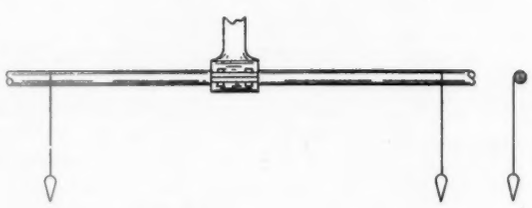

FIG. 1

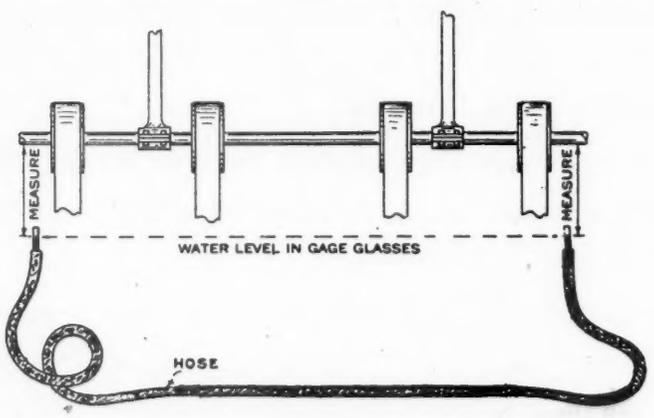

FIG. 2

Fig. 2. No matter how far the ends of this hose are apart, the water will always assume a perfect level and you can be certain as to whether or not the shafting is absolutely level. The only thing to watch out for is: Be sure that there is no air in the hose—that it is full of water—and be sure that the temperature of the water is the same from end to end. If one end of the hose is hot and the other end cold it will not be accurate.—W.F.S.

FIG. 1 shows an excellent way in which to align shafting longitudinally. Simply suspend plumbbobs around the side of the shaft, as indicated, all being suspended from the same side. If there are at least three such plumbbobs, it is a simple matter to glance along them and see whether or not the shaft is in alingnment. If the plumbbobs are rather far apart you can stretch a thread close to the vertical threads leading to the plumbbobs and you can then measure the misalignment, if you wish, with almost perfect accuracy. The plumbbobs suspended in this way are all perfect tangents to the shaft, and, knowing the diameter of the shaft, there can be no question as to where the center of the shaft is.

As for aligning shafting vertically, to make sure that it is level, one may use an ordinary garden or other hose filled with water, with gage glasses inserted in the ends, as indicated in

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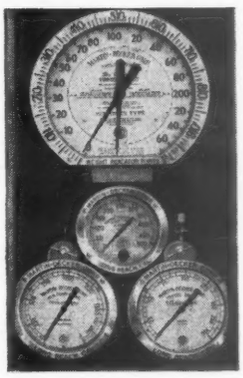
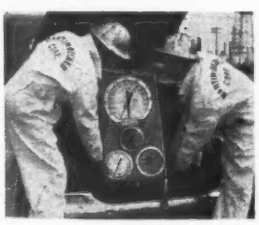


Clipper "Sealtite" installed in small floor space.



The Clipper "Sealtite" is so compact that it is easily transported.

THE CLIPPER "SEALTITE" Weight Indicator and Drilling Control Instrument provides the driller with information on all of the important drilling factors—not just weight alone.

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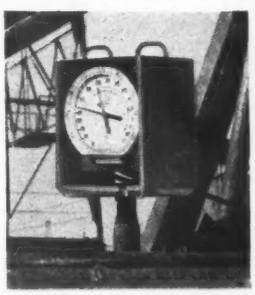
The Clipper *"Sealtite"* Production Model WEIGHT INDICATOR provides accuracy, sensitivity, and ruggedness for small rigs

The Portable Model is 14" x 17" x 12". It can be easily moved from rig to rig or can be mounted permanently on mast or derrick if desired.

Back view shows "Sealtite" construction, hi-pressure hose.

A Martin-Decker Production Model Weight Indicator Gauge can be placed anywhere you want it—at the brake, in front of the driller, over next to the line permanently attached to the mast where it can be seen by the driller—without danger or damage from dead line vibration or whip, and with it you can read your loads with precision in pounds. Equipped with supersensitive Vernier for maximum sensitivity and readability. Vacuum loaded at the factory and permanently sealed. Easy to install and move. No adjusting, no pumping and no moving problems—just leave it installed on the mast.



A Portable Model Clipper "Sealtite" installed on Ideco H-40 rig. Portable models are ideal for any small space.

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The Portable Model Clipper "Sealtite" is so light and compact that it can easily be moved. Note convenience of handles.

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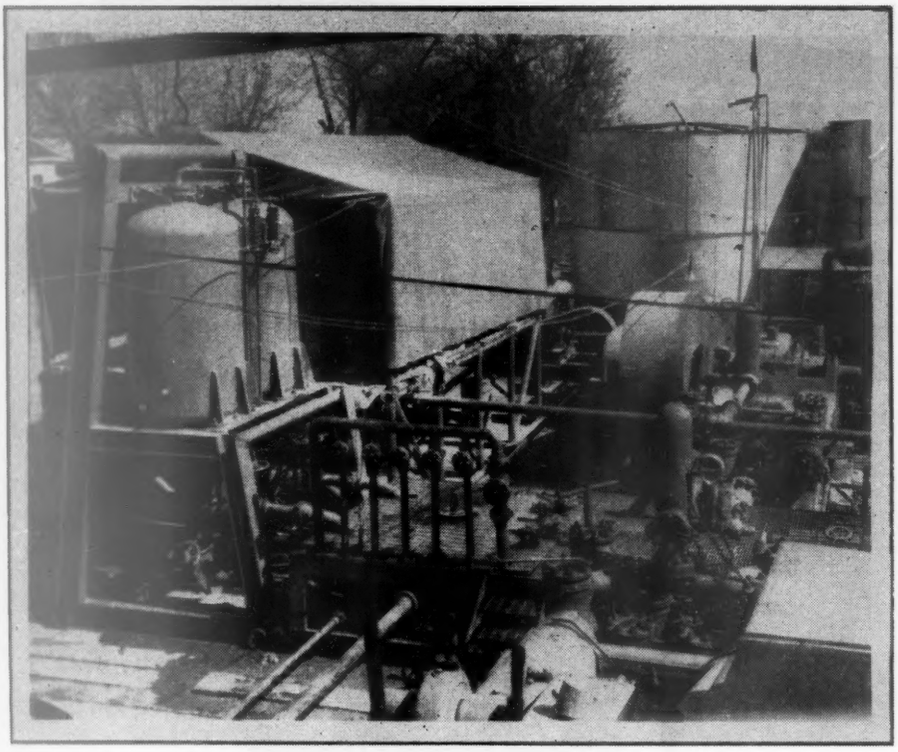

Series operation of mud pumps in Matagorda County, Texas, for two 10,000-ft wells was made possible by two air chambers 42-in. OD and 90 in. tall. One was between high and low-pressure pumps; the other in discharge side of high-pressure pump.

Mud Pump Selection

H. L. WILLKE*

As the development of larger drilling rigs proceeds and deeper drilling is encountered the slush pump is taking on a greater and greater degree of importance.

In the twenties and early thirties most all rigs were steam driven and it was not difficult to build a steam pump with sufficient capacity to meet the requirements of the times.

This does not mean that developments and refinements were not necessary to obtain better service, but it does mean that capacity was not a principal problem.

The steam pump was a simple mechanical device with almost no limit in its capacity within the bounds of a portable unit. By the late thirties, steam slush pumps of 900 hp capacity were available weighing approximately 23,000 lb, which in oil field terms, could be easily moved.

In addition to these factors, the nature of the steam pump allowed it to be used in multiples so that in reality the steam generating plant and other rig facilities were the only capacity limiting factors.

Unfortunately, the very thing that gave steam pumps their unlimited mechanical capacity became their economical limitation. As competition in the oil industry became keener, the high cost of steam generation and water problems caused the use of steam rigs and pumps to become more and more prohibitive depending upon local conditions.

Internal combustion engine developments at that time, particularly, had advanced further in the direction of cheap power. It was then natural that most future developments came in so-called "power rigs." It is no secret now that the first power rigs were equipped with inadequate pump capacity, although it is doubtful whether this fact was fully recognized at the time. Rigs were being equipped with pumps that weighed and cost more than twice as much as steam pumps, but which had only about two-thirds of their capacity. Power pumps were further handicapped in that they could not be used in series.

It was no longer possible to simply make the pump larger at reasonable increases in weight and cost as these factors were approaching economical and transportation limitations of that period.

Mud Flow Data

It became necessary for engineering staffs of operators and manufacturers to learn more about the functions of the pump related to drilling and to properly apply the capacity available.

Research on the characteristics of mud flow was begun by Herrick (1), 1932; Pigott (2&3), 1933 and 1941; March and Gilbert (4), 1935; and others.

These developments came at about the same time as the advent of full hole tool joints, and clearly substantiated their use. Principal interest was to reduce pressures and increase drilling range. Although it was realized greater circulation increased penetration rates, its full significance was not appreciated.

These early works contributed greatly to the understanding of mud flow characteristics. It was demonstrated that drilling muds acted almost like a true fluid in turbulent flow, while in viscous flow it was greatly different. It became possible to calculate mud pressures when the viscosity-velocity relations and the density of the muds were known.

Unfortunately, these analyses were considerably in advance of field practices, where at times not even the circulating rates were observed. For pump application a more practical and applicable method was necessary for general use where mud characteristics were not always known in advance.

Over this same period the writer's company accumulated flow data from rigs operating in all sections of the oil country. When this vast amount of data was compiled it appeared that the

*Chief Engineer, Toledo Plant Division, The National Supply Company, Toledo, Ohio.

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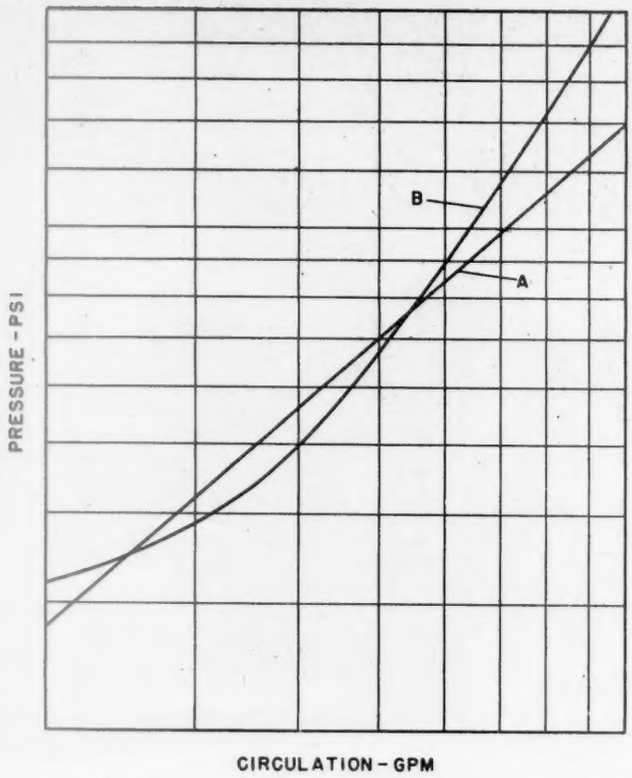

FIG. 1. Sample of early field data versus theoretical data.

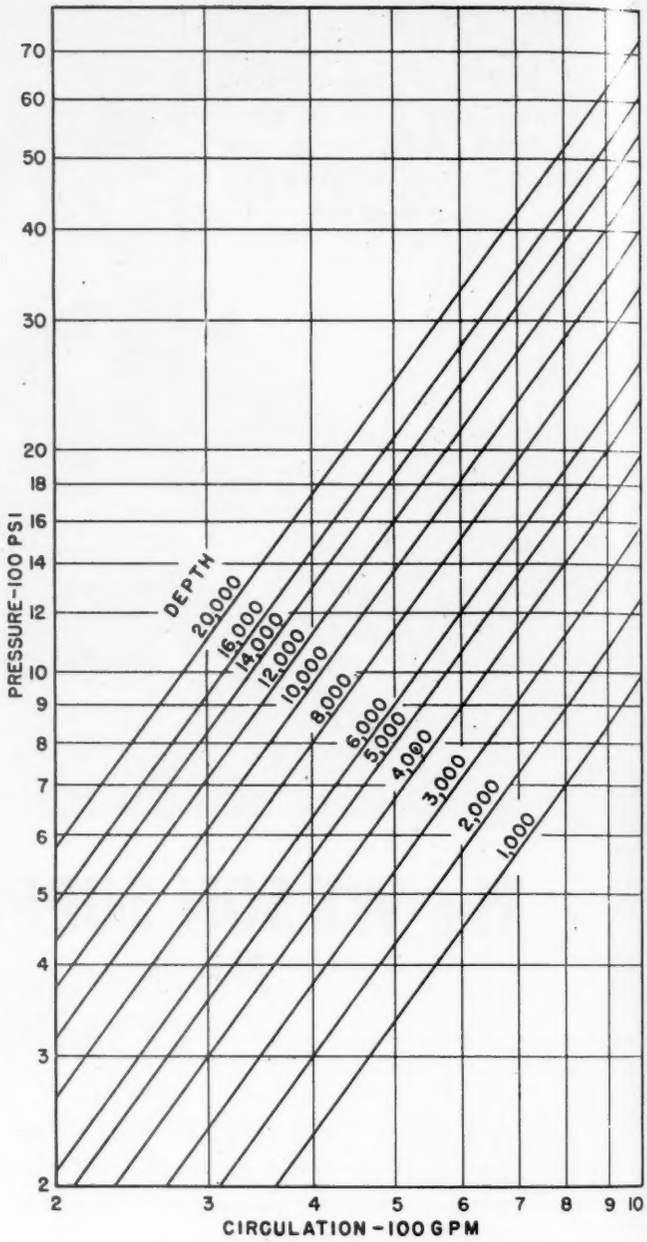

FIG. 2. Pressure-volume-depth curves for 4½-in. internal flush drill pipe.

pressure varied directly in proportion to the circulation rate for any given hole and mud condition. While these empirical data checked quite accurately against field results they could not be reconciled by more theoretical methods. The field data reflected field practices and covered only a relatively small range of volumes. These volumes and circulation rates bridged the region between predominantly viscous and predominantly turbulent flows. Curve A, Fig. 1, illustrates the straight line relationship of pressure and circulation as derived from field results. Curve B illustrates the theoretical pressure relationship to circulation rate as the flow progresses from predominantly viscous to predominantly turbulent conditions. The flat portion of Curve B will vary because viscous flow pressures are greatly affected by the viscosity of the mud. It can be seen, however, that the empirical curve represented a reasonable average of the theoretical values.

As circulating rates were increased, it became evident that the original field data interpretation was in error in the large flow region. Additional data were collected and the curves replotted. The basic equation for these replotted curves is $P = (K + K_1 D) V^{1.6}$. From this equation it can be seen that, instead of varying directly as the volume, the pressure under higher rates varies as the 1.6 power of volume.

A sample of these curves presenting 4½-in. drill pipe with internal flush tool joint flow data is given in Fig. 2. These curves lack accuracy in small flow rates where viscous flow exists in the drill pipe, but this has little bearing on the maximum loads encountered on a slush pump application. Also, these curves are only applicable to conventional bits, and with the advent of jet bits additional data will be required.

Recent contributions to the knowledge of mud flow characteristics have been made by Beck, Nuss and Dunn (5) and also by Nolley, Cannon and Ragland (6). The former have developed a theoretical formula for computing slush pump pressures and the latter have compiled field test data including jet bit pressures and penetration rates.

As a matter of interest, results from a number of these methods are presented in Fig. 3. While all of these curves are for 4½-in. drill pipe, other conditions are not well enough fixed in published data to allow direct comparisons. It is interesting to note the general agreement in the slope of the curves and the fair correlation in pressure magnitudes even though well and pipe conditions are somewhat different.

Pigott and also Beck, Nuss, and Dunn have done some work to determine the pressure drops in the annulus. With higher flow rates they have demonstrated that the annulus flows are often turbulent and as a re-

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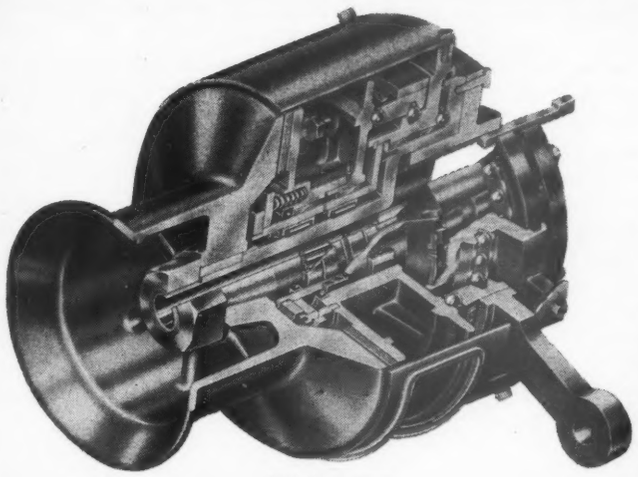

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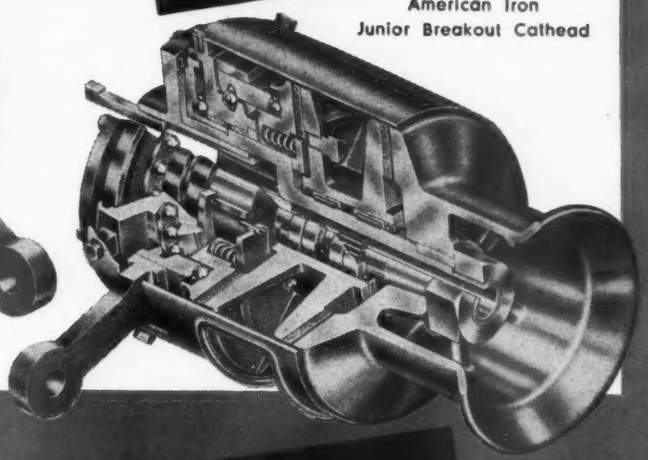

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sult represent a fairly high percentage of the total pressure drop. This is important from the operators' standpoint because in some cases this adds enough to the bottom hole pressure to cause loss of circulation.

This is an indication that maximum annulus velocities may be reaching their optimum values, particularly in softer formations.

Even though annulus velocities may be reaching their ultimate, required pump capacities will not necessarily reach their ceiling. Jet bits in the present state of development have proven that penetration rates can be greatly increased except in harder formations for a given circulation rate. The added nozzle velocities obviously reflect an increase in the pump pressure and horsepower. It is reasonable to expect these developments to continue, and the pump to perform more and more work.

Selection of Pump Size

It must be admitted that the rig horsepower has too frequently been the determining factor for the selection of a pump size. For hard formation drilling the horsepower requirements for satisfactory hoisting and for circulating and rotating were near enough alike that rigs proportioned for adequate hoisting capacity had sufficient pump capacity. In softer formations, however, independently driven pumps have had to be added to take advantage of the higher penetrating rates possible.

To make a proper pump selection the hole size and drill pipe size and type must be known for the most difficult holes contemplated for a rig.

Fig. 4 illustrates this problem in connection with a 20,000 ft well in which it is possible to set 7-in. OD casing at 20,000 ft. The 7-in. OD casing would not necessarily be set as an oil string, but would be held in reserve for an emergency. This requires that 9⅝-in. casing be carried as deeply as possible. In this example it is assumed that the 9⅝-in. will be set at 15,000 ft requiring a 12¼-in. hole to this depth.

Using flow-of-slush data for 5 in. OD drill pipe it is found that 1400 hyd hp pump capacity is required to maintain 3 ft per second annulus velocity in the 12¼-in. hole. Three feet per second has been expressed as a minimum desirable annulus velocity and even with jet bits maximum penetrating rates are obtained with higher velocities (6).

Special attention to weight requirements and new and novel bearing applications have made possible the building of power slush pumps capable of performing the requirements of 20,000-ft drilling. These pumps are well within the transportation limita-

FIG. 3. Pressure-volume curves for 4000 ft according to several published investigations.

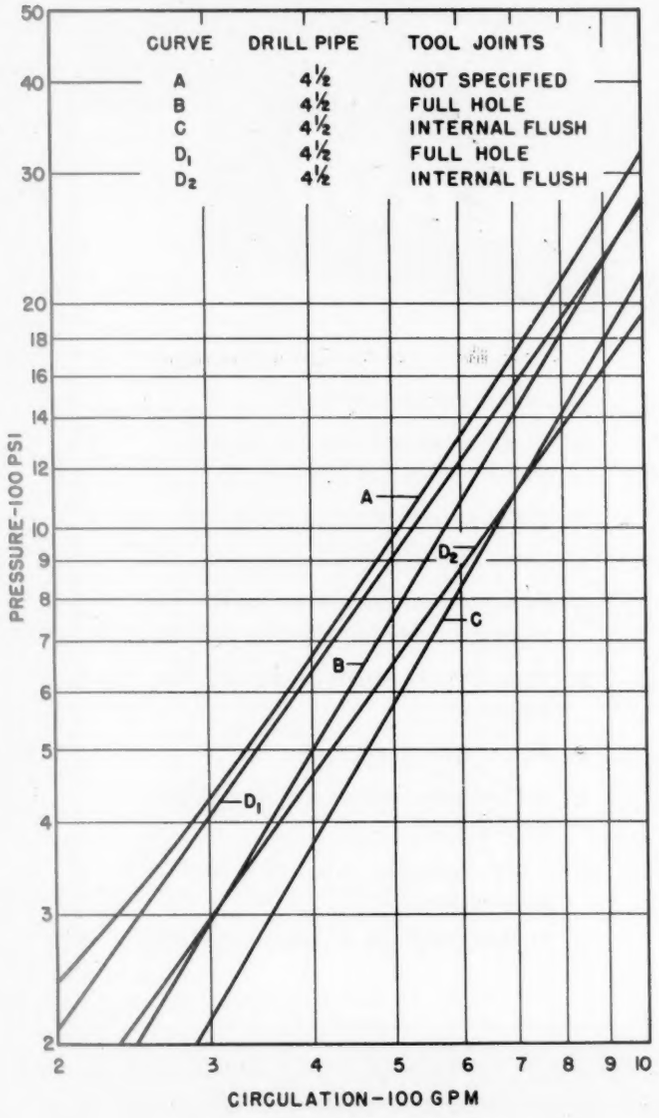
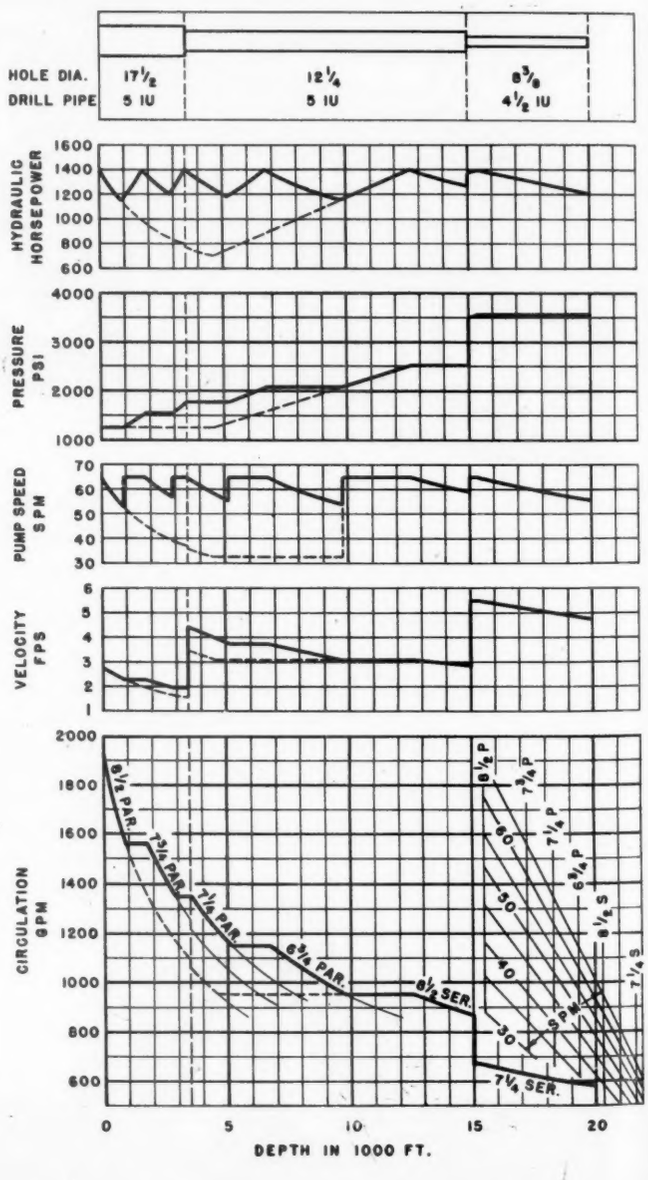


FIG. 4. Mud pump performance versus well depth.



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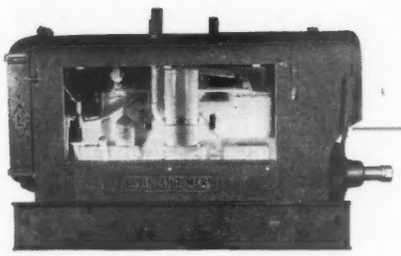
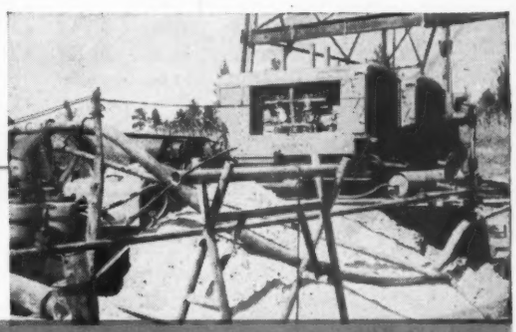
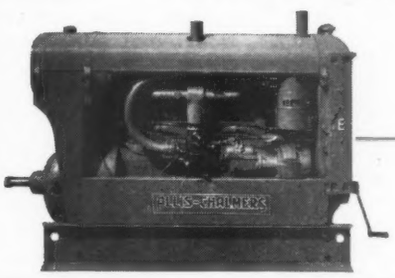


A-C Model L844

6 cyls. 5¼" x 6½"
844 cu. in. disp.
110 bhp at 1050 rpm
Torque 590 ft. lbs. at 700 rpm



LOW INITIAL COST



A-C Model E563

4 cyls. 5¼" x 6½"
563 cu. in . disp.
74 bhp at 1050 rpm
Torque 400 ft. lbs. at 700 rpm

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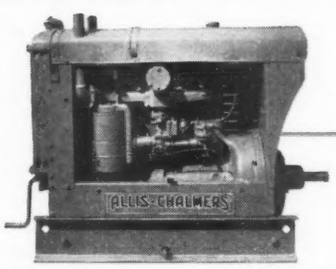
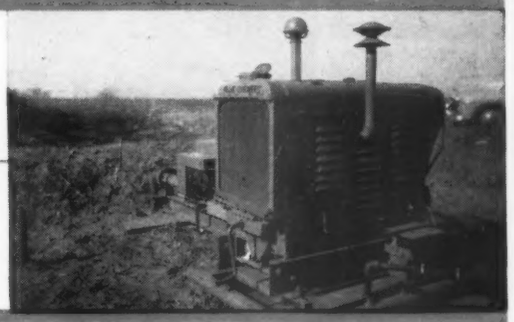
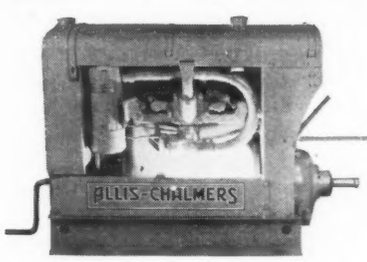


A-C Model U318

4 cyls. 4½" x 5"
318 cu. in. disp.
51 bhp at 1400 rpm
Torque 200 ft. lbs. at 900 rpm

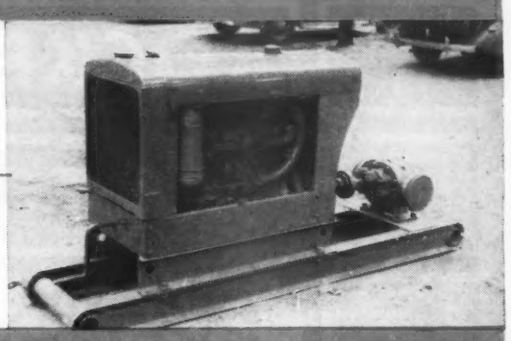


LOW FUEL and LUBE COSTS

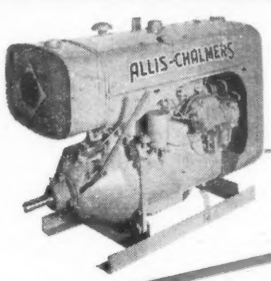


A-C Model W201

4 cyls. 4" x 4"
201 cu. in. disp.
34 bhp at 1400 rpm
Torque 128 ft. lbs. at 1200 rpm



LOW MAINTENANCE



A-C Model B125

4 cyls. 3⅜" x 3½"
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Torque 87 ft. lbs. at 1100 rpm

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tions of modern hauling equipment. At least two large power pumps of sufficient capacity are available. To obtain maximum drilling rates even these must be used in multiples. In Fig. 4 it can be seen that under large volume low-pressure top-hole conditions parallel operation is required for 10,000 ft. Beyond this point the pumps can either be operated in parallel with very small liners or preferably in series with large liners.

Series operation of power pumps has now been proven to be practical, mechanically, but its application is not yet widespread due to the lack of experience and the cost and availability of adequate air chambers essential to all but very low speed operation. These factors are not prohibitive where large pump requirements are involved and it is expected that with further developments, series operation will become popular in medium pump requirements.

The principal advantages of multiple pump operation are, first, greater versatility in a two pump arrangement and, second, improved fluid end parts life.

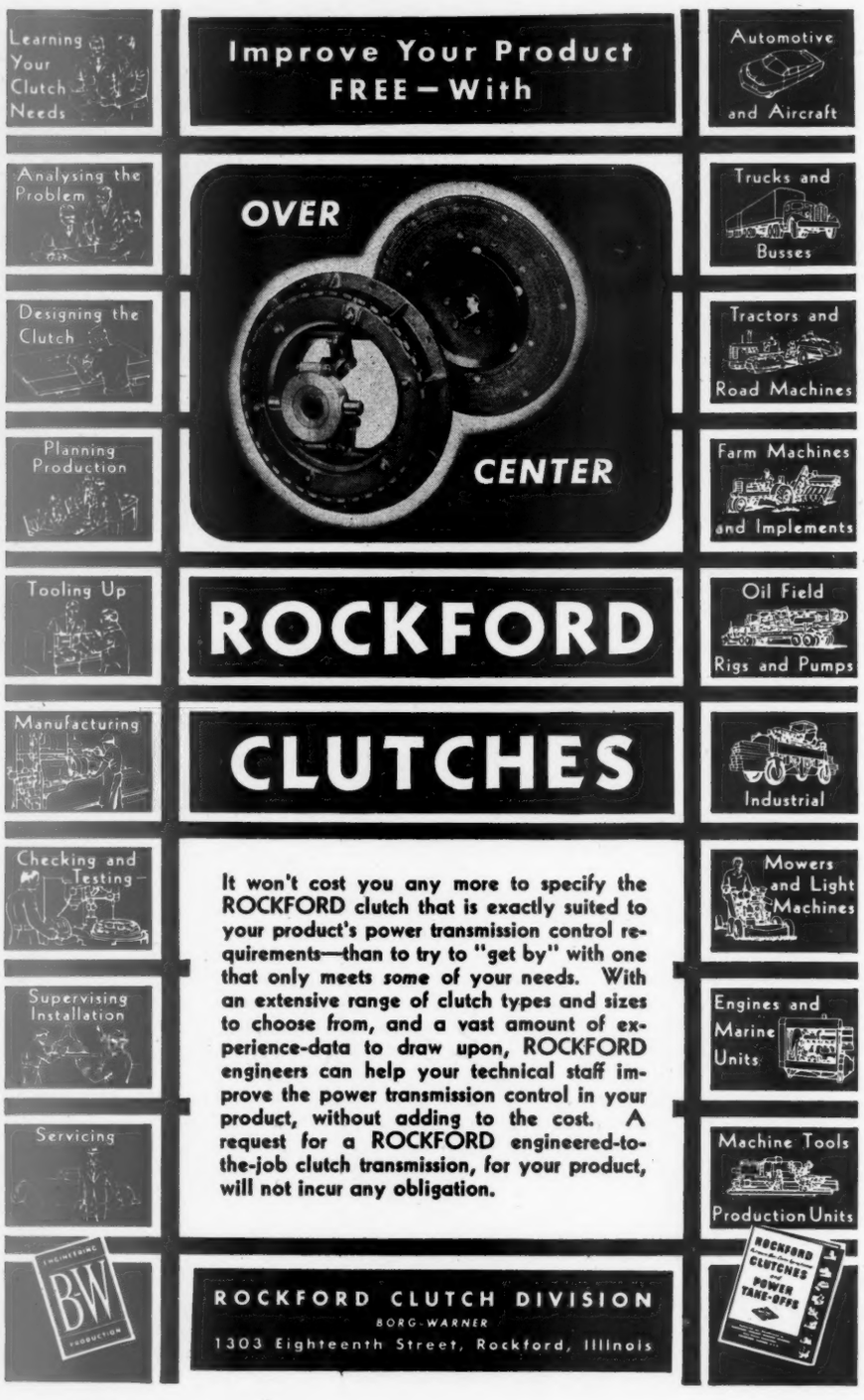
In multiple pump operation the pumps are used in parallel under top-hole large-volume conditions and in series during the high pressure drilling of a well. This makes possible a considerable reduction in the number of liner and piston sizes, resulting in lower inventories than would be required for a single pump operation. Also for a single pump to accomplish the same volumetric displacement, the fluid end would have to be of considerably larger proportions.

Although in series each pump handles the full displacement, the low pressure pump takes fluid from the suction tank and discharges it into the suction of the high pressure pump, which in turn boosts the pressure to full manifold value. Thus each pump is subjected to a differential pressure equal to only one-half of line pressure. It is obvious that the pump wearing parts of the low pressure pump are thus protected against the full severity of full line pressure. Similarly the high pressure pump is protected against the full severity of line pressure by its being subjected to a differential pressure only. It is easy to see that valve work under this condition is reduced as it is only sealing the differential pressure, and it is known that pistons and liners obtain like benefits. Also, large pistons normally used in series work are inherently better than extremely small pistons.

For most satisfactory multiple pump operation it is best to have a third pump of like size to be used in case of a shutdown of one of the two line pumps. It is not always possible to have an extra pump, however, and when one pump must be shut down it is interesting to note that series operation has an advantage over parallel operation. When one pump of a parallel operation is stopped, the remaining pump will supply 50 per cent as much dislacement, 33 per cent as much pressure, and the horsepower as a result will drop to 17 per cent of that originally supplied.

In series, the remaining pump tends to continue full displacement and would do so if sufficient engine horsepower were available. With engines proportioned to the pump size, the pump speed will be reduced until the engine horsepower capacity balances that of the pump load. This point occurs when the displacement is equal to 65 per cent, producing 50 per cent pressure and as a result 33 per cent horsepower. Examination of Table 1 will help clarify these two examples.

If sufficient horsepower is available, added work can be done up to the overload capacity of the pump. Thus it can be seen that during an emergency period, with one pump shut down, the remaining pump of a series arrangement can deliver from two to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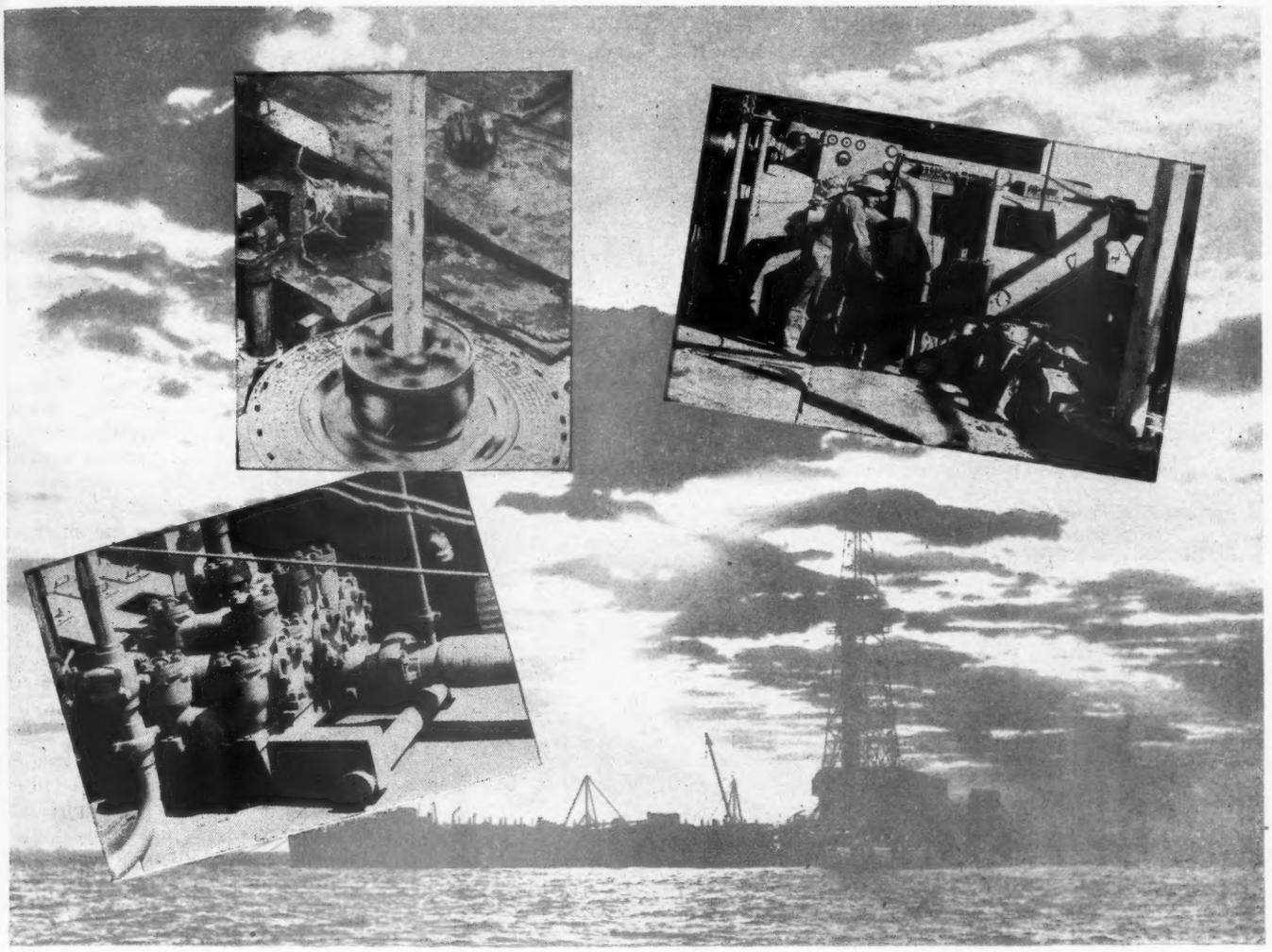

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four times as much horsepower as one of a pair of parallel pumps. These overload conditions are also tabulated in Table 1.

Another advantage of series operation is the availability of accumulative pressures for emergencies.

Types of Drives

Along with the increase in pump capacity requirements, there has been also a growing need for better speed control for circulating or contributing functions. The conventional mechanical drive lends itself well and efficiently from rated speeds down to approximately 50 per cent speed. Under some drilling conditions this reduction in speed does not reduce the circulation rate sufficiently to reduce the horsepower load to within the engine capacity. Under this condition the engines will stall and the only recourse is to reduce the liner sizes or in extreme emergencies to inactivate one of the pistons.

In many cases the drive ratio is purposely increased to lower the pump's maximum operating speed, throughout the entire drilling operation, to avoid excess circulation and pressure when it becomes necessary to use small drill pipe for well completion. This is obviously a compromise.

Two-speed mechanical drives have been introduced to expand the mechanical drive speed range to both higher and lower values.

A low speed ratio presents the possibility of greatly overloading the pump. In cases of emergency this is often necessary and justifiable, but care should be taken not to operate under these conditions over extended periods of time.

Under other conditions where smaller volumes are required than are possible with minimum pistons, a low speed ratio will actually avoid a pump and engine overload.

Hydraulic coupling applications on rig drives have mounted to a point where a large portion of big rigs are so equipped. It has been recognized that the hydraulic couplings have provided an ideal drive for the hoisting portion of the rig, giving these advantages: Shock-absorption between the engine and transmission; isolation of the engine mass system so that torsional vibrations can be avoided or at least reduced to a minimum; and excellent speed control under full engine torque without the danger of stalling the engines.

Many of these advantages are carried over into the application of a hydraulic coupling on a pump drive. Aside from these equipment-saving features, the point uppermost in the user's mind is the ability to operate the pump at full pressure and low vol-

TABLE 1. Standby characteristics of multiple pump operation (7).

Pump combination	Piston diam.	Pump rpm	Volume total	Volume 1 pump	Pressure total	Pressure 1 pump	Hyd hp total
1 Two in parallel	6¼	65	970	485	2,500	2,500	1,400
2 One of parallel	6¼	65	485	485	825	825	235
3 Line 2 in per cent line 1	...	100	50	100	33	33	17
4 Two in series	8½	65	970	970	2,500	1,250	1,400
5 One of series	8½	42	630	630	1,250	1,250	460
6 Line 5 in per cent line 4	...	65	65	65	50	100	33
7 One of series, 125 per cent load	8½	48	720	720	1,560	1,560	670
8 Line 7 in per cent line 4	...	74	74	74	63	125	48
9 One of series, 150 per cent load	8½	54	810	810	1,875	1,875	890
10 Line 9 in per cent line 4	...	83	83	83	75	150	64

Assumptions: Pressure varies as 1.6 power of ratio of volumes hp varies as 2.6 power of ratio of volumes.

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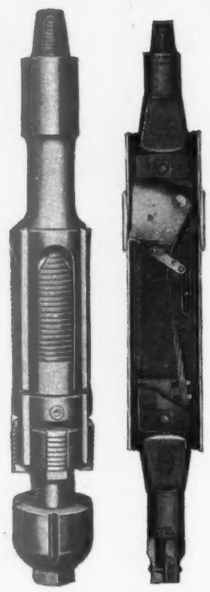

Fig. F501 Fig. F515

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Fig. F515

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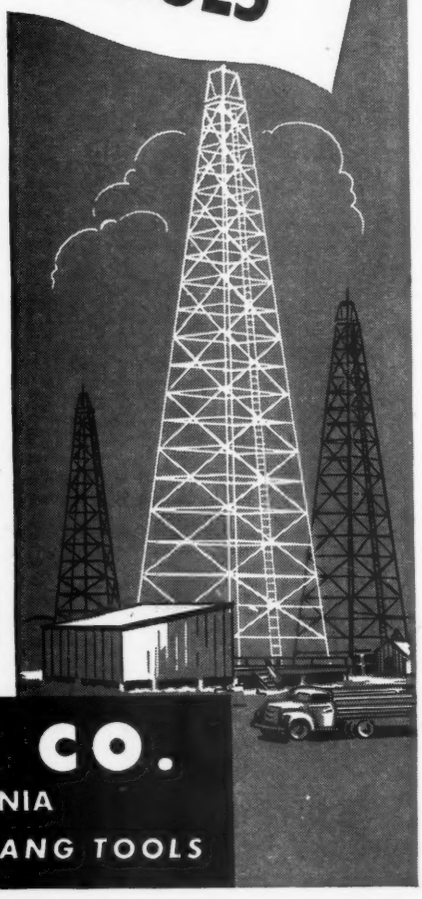

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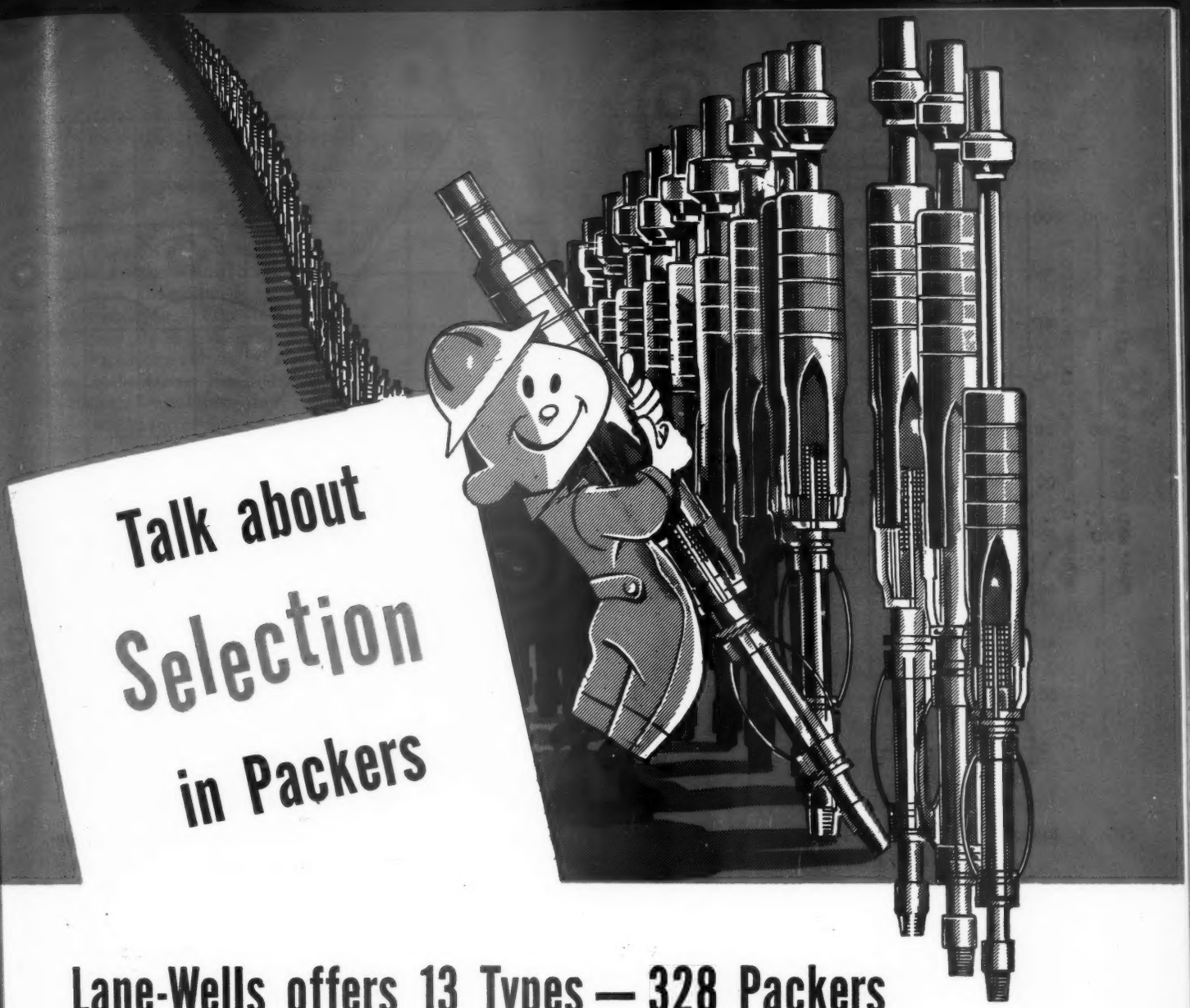

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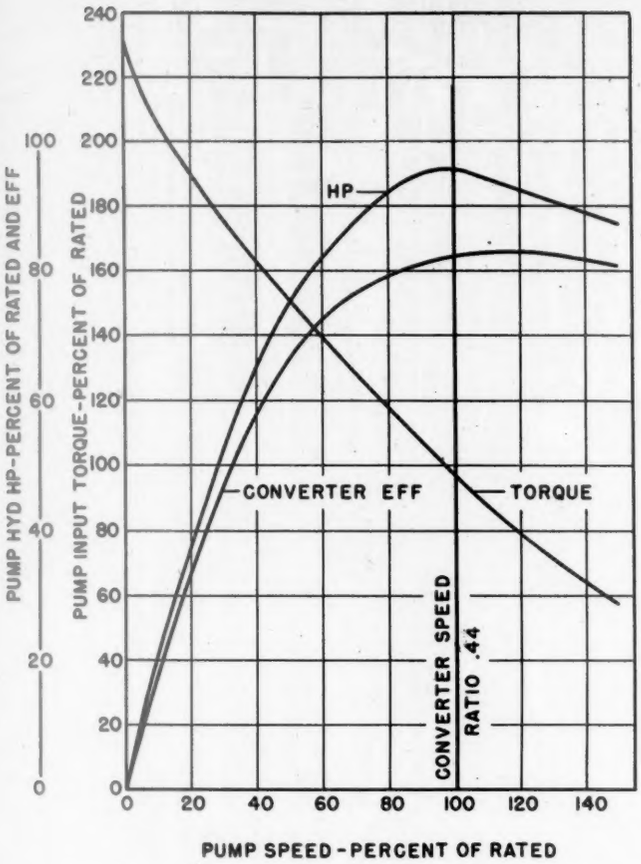

FIG. 5. Performance characteristics of three-stage torque-converter pump drive.

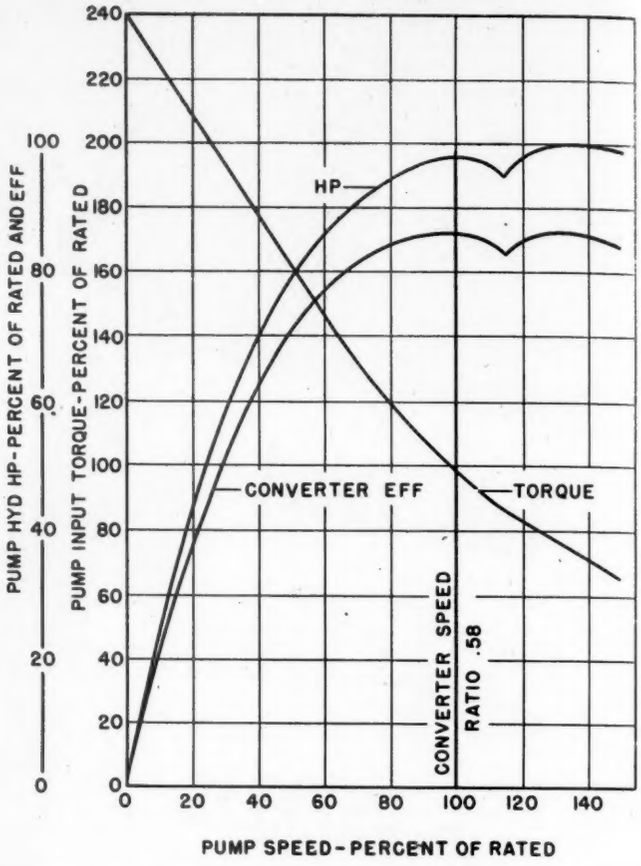

FIG. 6. Performance characteristics of single-stage torque-converter pump drive.

ume at, or near, stalling conditions. The operator can rest assured that the engine will not slow down beyond the speed at which maximum torque occurs.

Under the discussion of two-speed pump drives, this paper mentions that occasional high-pressure low-volume overload conditions are probably necessary and justifiable during emergencies. These high pressures at near-stalling speeds also can be obtained by operating pumps in series, taking advantage of the favorable hydraulic coupling characteristics. Due to reduced inertias at these slow speeds, the couplings alone can compensate the fluctuating volume condition between pumps. These problems have been discussed in detail in a previous paper (8).

In driving pumps, torque converters facilitate a minimum number of piston diameter changes, making possible the drilling to moderate depths with only one piston size.

By properly proportioning drive ratio, the pump can be operated at high speeds under top-hole large-volume conditions. The light gas-free mud commonly used at the top of the hole generally will allow speeds in excess of rating.

The torque converter has substantially the same shock-absorbing characteristics as the hydraulic coupling and serves equally well as an equipment saver.

The principal difference is that the torque converter provides a means of multiplying the torque to the pump shaft. This provides for emergency high pressures with a corresponding pump overload. To obtain this added versatility a compromise is necessary in over-all efficiency, as the converter is less efficient than a straight mechanical drive or a hydraulic coupling in the usual operating range.

Since the application of a torque converter is somewhat complex, Figs. 5 and 6 are included to demonstrate the principle of applying three-stage and single-stage converters to a pump.

In the case of the three-stage converter (Fig. 5) the drive ratio is arranged so that the converter output shaft is operating at 44 per cent of the input shaft speed when the engine and pump are running at rated speed and load. Thus the maximum horsepower delivery of the converter coincides with the rated pump speed under full load conditions. The maximum horsepower delivery point has been chosen rather than the maximum efficiency point for two reasons. First, the delivered horsepower to the pump at rated speed is slightly greater and, second, the torque multiplication to the pump input shaft is somewhat reduced.

This method of applying a converter to a pump results in the following: Maximum horsepower is delivered to the pump through its favorable operating speed range, overspeed is made possible with usable pressures, and the over-all torque-multiplication under stall conditions is brought more into line with the pump's mechanical strength for short-period high-pressure emergencies.

The single-stage converter (Fig. 6) is applied substantially in the same manner, but it must be remembered that this converter is slightly more efficient, particularly for low speed reductions through the converter itself (high converter output shaft speeds). Appyling the converter at a higher speed ratio appears attractive because of the higher efficiency, but to do so the pump overload would be further increased.

The versatility of the torque converter drive is better illustrated by examination of Fig. 7. In this figure pump performance for a single-stage torque-converter drive with a single liner size is superimposed on mechanical drive performance with four liner

sizes. The mechanical drive may be with or without hydraulic couplings.

The pump performance is measured in displacement and pressure against well depth. It can be seen that the mechanical drive, when ample liner changes are made, will establish higher volumes and resulting higher pressures than the torque-converter drive because of the better over-all efficiency. It is noted, however, that the displacement curves for the mechanically driven pump show a greater decrease in volume than the curves for the converter-driven pump as the depth increases. When the pump is forced to slow down, as drilling progresses, the decrease in pump horsepower is less with the converter drive, even though the converter efficiency is reduced. Thus a liner size can be used over a greater depth range.

For the user to derive the benefits of converter versatility, compromises must be made in the maximum horsepower delivered by the pump and the reduction of pump life if overloads are allowed, at reduced speeds, over an extended period. The user's requirements will largely determine whether the benefits outweigh the compromises.

No illustration is provided for the three-stage converter as it is substantially the same as for the single-stage.

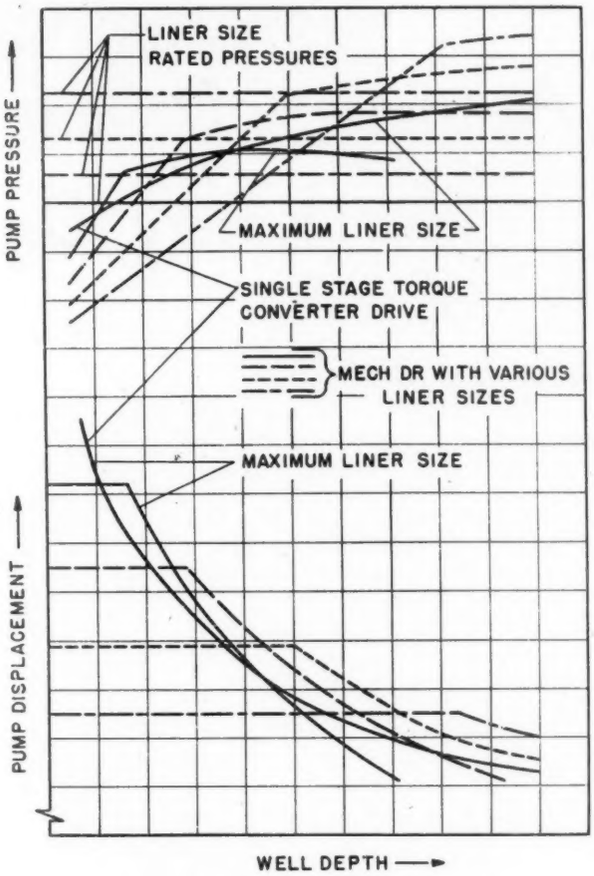

FIG. 7. Comparison of converter and mechanical drive performance.

Relation of Pump Load to Rating

This paper has discussed several applications which allow extreme overloading of the pump on a torque basis, even though the engines have been selected to exactly match the pump capacity at its rated speed.

A point which has not been discussed is the prevalent practice of supplying excess engine capacity to reduce engine maintenance.

It is one of the purposes of this paper to point out the qualifications upon which these practices become sound engineering.

A soundly engineered pump rating is largely based on durability since such important elements as gears and bearings are rated on this accepted practice. The relative life-load relationship of these parts can be computed. The nominal rating may be selected on the basis of a high rating with short life or a low rating with long life.

Parts rated on a conservative durability basis will have an excessive strength measured in terms of yield or ultimate strengths.

Other parts when designed for satisfactorily low deflections will have similar reserve yield and ultimate strengths.

This makes possible the operation of power pumps at large overloads for a short period without any visible damage. However, it must be remembered that on a durability basis, life varies inversely with approximately the third power of load. For example, the bearing industry has determined that an increase of 100 per cent load on a bearing will reduce its life to between 1/10 and 1/8 of the original value.

It is then obvious that to obtain reasonable life, pumps must be operated at or below their rating a large portion of their operating time. However, it appears to be good engineering to provide sufficient excess engine horsepower to obtain good engine performance and to meet any short duration emergency that is necessary for the successful drilling of a well.

Flow-of-slush data have been developed to the point where pump horsepower requirements can be anticipated and proper pump sizes selected to obtain maximum performance. Because the advantages of higher annulus velocity and greater jetting at the bit nozzles are being recognized, higher hydraulic circulating power is required. Higher-powered lighter-weight pumps, and parallel and series operations are available for these conditions. Pump designs must be well balanced and ratings and applications made with some conservatism to give satisfactory life under the widely varying load conditions encountered in drilling.

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Part 1

Automatic Drilling Feed Controls for Rotary Drilling Rigs*

W. S. CRAKE†

A VERY considerable amount of detailed study and thought, design and field testing of various means of achieving the desired results has gone to bring work on drilling controls to their present status. Up to the present, however, the results of this study and work have not been recorded except in improvement in machine performance. This paper is not primarily intended to be an evaluation of the results of automatic controlled versus hand controlled drilling, but it is felt by the writer that the subject is of major importance in reducing drilling costs and that all those factors which have been considered, and the analyses of the problems, should be placed on record. Others may wish to extend or revise the analyses and build or purchase similar devices, and this report will, it is hoped, save them from having to duplicate the efforts of the past few years and to determine if the machines designed or offered have the required characteristics.

It is the writer's conviction that the hardest part of this work has been to study action and reaction of various controller machine parts on the well and piece together a reasonably accurate technical picture of the requirements of the job. The next most difficult job, with little previous experience, was to study and understand complex control instruments of various types and place them in the picture.

It has long been recognized that the maintaining of constant loading on drilling bits will result in more footage per bit and more footage per unit of time, all other factors being equal. The result is fewer round trips with their horsepower hours, wear and tear on rigs, etc.

The best of hand-feed brake levers is a poor substitute for full automatic control, since worn brakes creep off and either "drill off" or "pile on" weight. Most are worse than this in that they frequently drop off from ¼ to ½ a drum revolution suddenly when worn. It is physically impossible for a man to feed constantly for long time periods, just as it would be on a lathe or other machine tool.

The author intends to avoid the term "automatic driller" in case any reader should misconstrue the purpose of automatic drilling controls. They make the driller more indispensable than ever, but require him to exercise his judgment more than his muscle. There is no insinuation that a constant single weight is desirable for drilling any more than a constant machine toolspindle speed or feed rate, or a single type bit, would drill a composite block of plates of lead, steel, copper, concrete, and clay satisfactorily.

With automatic control, the driller can watch his drilling rate chart and his other drilling symptoms and adjust his feed weight and rotating speeds to obtain the best possible results. By making constant one of his drilling variable, i.e., the weight on the bit, the rotary speed automatically steadies down in any given formation and the table behavior becomes a very sensitive indicator of formation changes and types. The penetration rate indicator, or recorder, in most cases gives a clear graphic story of a bit becoming dull and can save many additional hours "hoping the bit will make a few feet more."

Analysis of the Problem

(a) *Relationship of bit load to hook load.*

The first question is "What is the relationship of the hook load to the bit load?" If there is not reasonable similarity, the problem becomes complicated or the solution impractical. The measured load on the hook is a relatively simple starting point, but measuring the load on the bit at the well bottom requires a vast amount of research and equipment yet undeveloped and the cost and complexity of this work could be out of proportion to the gains to be made.

(b) *Synthesis of the system.*

In order to arrive at an answer to the above question, let us synthesize the suspended system into analogous parts. Referring to Fig. 1, the drillpipe string can be assumed to be a simple spring of length L and the drill collar assembly becomes a short, stiff, heavy spring which, in effect, is a weight on the end of the drillpipe.

In Fig. 1, it is assumed that, with customary good drilling practice, enough drill collars are used to maintain the "neutral point" of load change from tension to compression within the drill collar assembly. This assumption is not necessary to the analysis or correct usage, but is used in the example.

Referring to Fig. 1

Wt on hook = W.

Wt of drillpipe = W_1.

Wt of drill collar assembly = W_2.

Wt on bit = W_3.

Remaining weight of drill collar suspended on drillpipe = W_4.

Since all wells are to some extent crooked, all the wall contact points, either steady, or periodical caused by vibration, cause friction forces between drillpipe and wall.

Then, in order to start the whole string in motion, without rotation, off bottom

$$W = W_1 + W_2 - \Sigma f \quad . \quad . \quad (1)$$

and, on bottom

$$W = W_1 + W_4 - (W_3 + \Sigma f) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

If pipe is lowered slowly off bottom, as while drilling, the weight indicator will read the result of (1) and, if on bottom, the result of (2).

If, however, the pump is started, thus vibrating the pipe, or if the pipe is rotated, the pipe weight plus W_2 or W_4 wipes out the friction effect for all practical purposes, except as a damping action against longitudinal vibrations. The weight will then read

$W = W_1 + W_2$ off bottom

and

$W = W_1 + W_4$ on bottom.

These conditions are analogous to the use of a vibrator to destroy friction in the movement on pressure gauge testing or to the practice of rotating

*Presented at the Petroleum Mechanical Engineering Conference, Amarillo, Texas, October 3-6, 1948 of The American Society of Mechanical Engineers.

†Chief Mechanical Engineer, Shell Oil Company, Houston, Texas.

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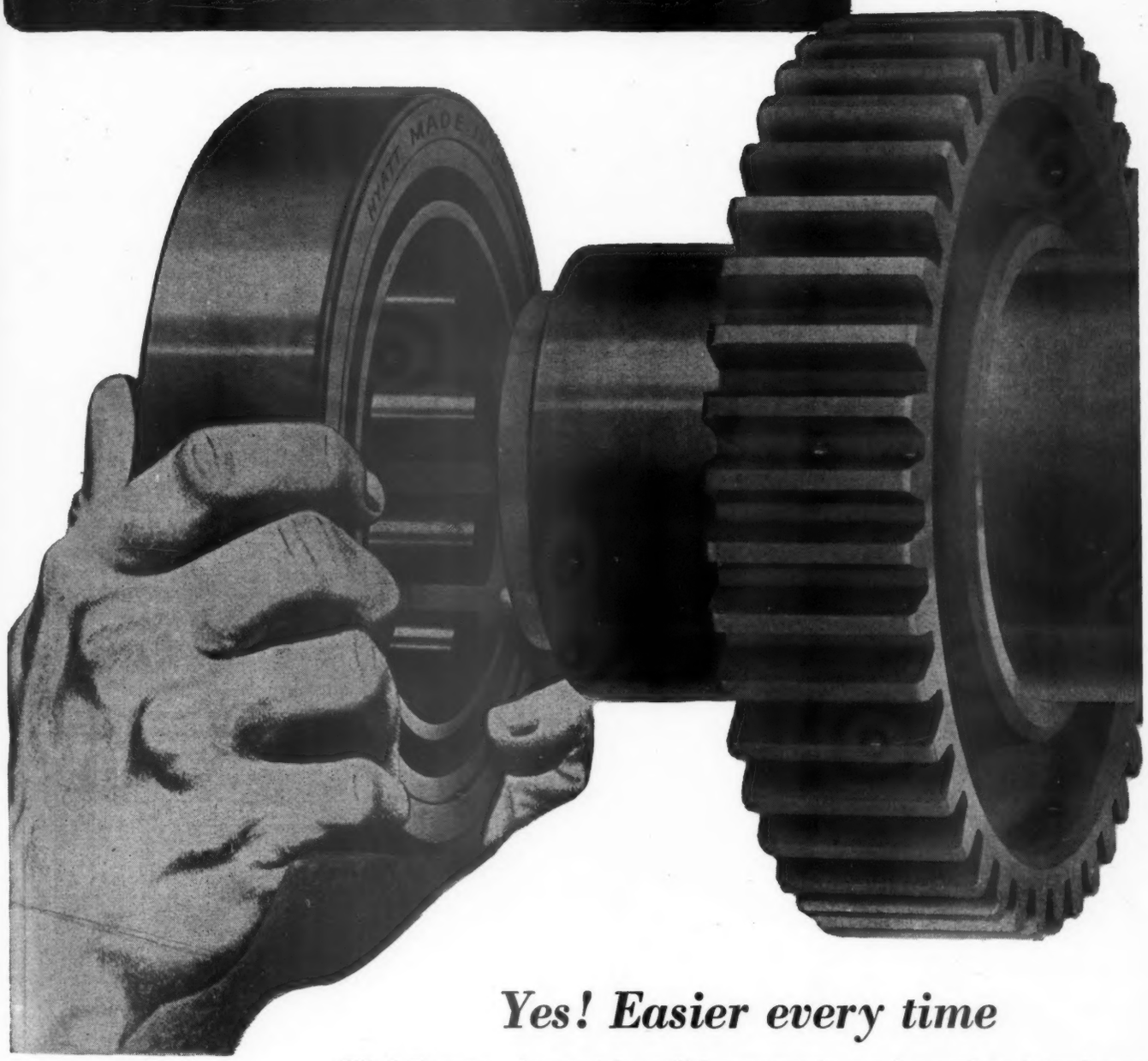

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the piston of a deadweight tester for the same purpose (see appendix.†)

By studying Fig. 2, the value of f_n, one of the numerous friction forces caused by, say, a tool joint touching on the wall, becomes

$$\mu \, a \, W_x \sin \Theta$$

and the sum of all these friction forces $= \Sigma \mu a \, W_x \sin \Theta$, or $\Sigma \, f_n$ where $\mu =$ coefficient of friction.

As long as W_x is greater than f_n, the above reasoning holds. If an extremely crooked hole or bent pipe causes W_x to be less than f_n, then this latter amount becomes a reduction in hook weight.

While rotating, $\Sigma \, f_n$ becomes torsional friction which remains as a torsional load on the rotary table.

The effect of torsion on the length of the drillpipe string is shown on page 1 of the appendix.

(c) *Strain in the system.*

Since the whole system is elastic, the strain (or stretch) of the pipe is obtained from the formula

$$e = \frac{72 \, L^2}{E} [\delta - 2 \, w \, (1 - m)] \qquad (3)^*$$

Where:

e = strain or stretch—inches

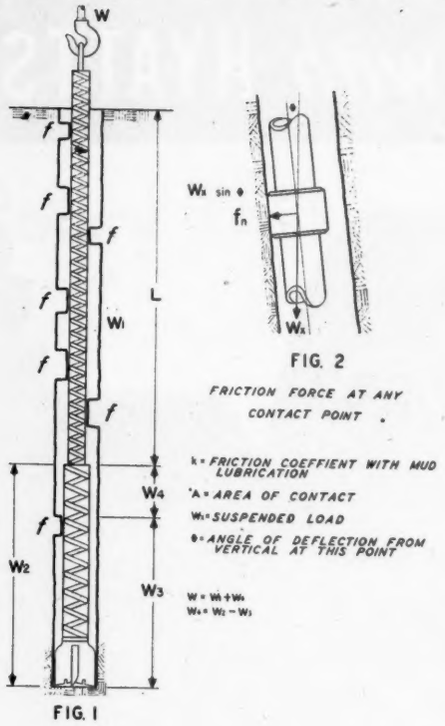

FIG. 1

FIG. 2

FRICTION FORCE AT ANY CONTACT POINT .

k = FRICTION COEFFIENT WITH MUD LUBRICATION
A = AREA OF CONTACT
Wx = SUSPENDED LOAD
Θ = ANGLE OF DEFLECTION FROM VERTICAL AT THIS POINT

W = W1 + W4
W4 = W2 − W3

L = length of string—feet
E = Young's Modulus—30,000,000 psi
δ = density of steel—lb per cu in.
w = density of flotant—lb per cu in.
m = Poissons ratio, or 0.28

The effect of adding drill collar weight W_2 is to add an equivalent load, less the buoyancy factor, in feet of pipe of a given weight. The equivalent length of pipe, with drill collars suspended

$$= \frac{W_2 \, (1 - \frac{w}{\delta})}{U} = L_2$$

Where:

U is the weight per foot of material in string L.

On bottom, the equivalent length of pipe with W_4 still suspended

$$= \frac{W_4 \, (1 - \frac{w}{\delta})}{U} = L_3$$

By recalculating the strain in formula (3) using $L + L_2$ or $L + L_3$ in place of L, new strains become easily determined. The difference of strain between the above two readings becomes the distance the kelly must lower after first contacting bottom in order to place load W_3 on the bit. These may be more easily obtained by reading the strains from sheet 10-050 of the Spang-Chalfant Engineering Handbook.

The existence of these strains actually provides additional equivalent

†See Appendix in Part 2.
*Spang-Chalfant Engineering Data Sheet 10-050.

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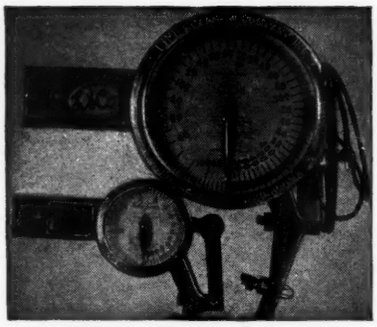

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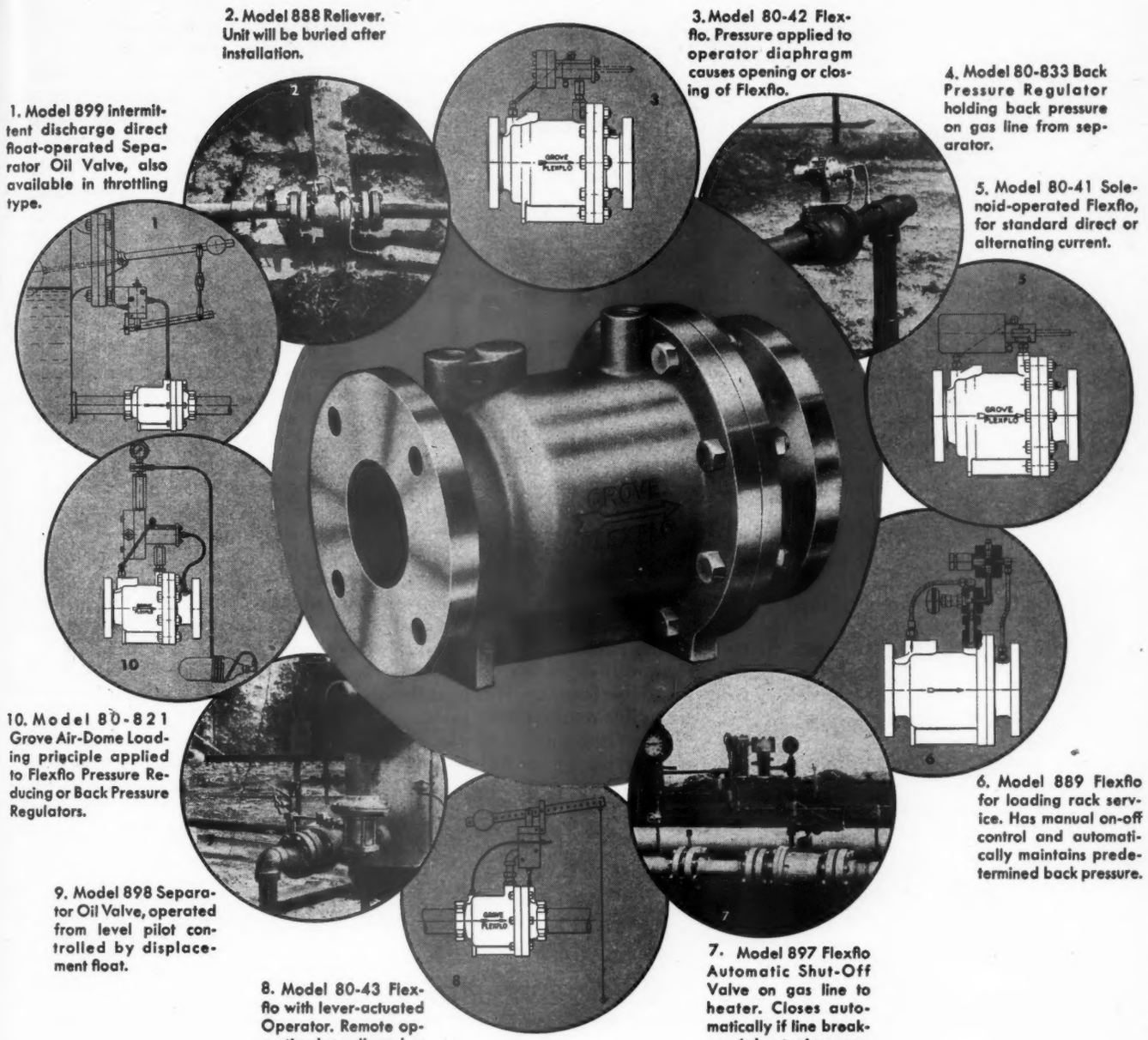

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time lag to help the controller function smoothly.

(d) *Forces acting on the string, and their effect on hook load.*

Forces acting on the string when "feeding off" are listed below. All forces acting downward are listed as positive +, and upward acting forces as negative —.

(1) Weight of equivalent pipe string (see above) +.

(2) Wall friction, depending on direction of movement + or —.

(3) Fluid friction of circulating fluid in drillpipe +.

(4) Friction drag of return fluid on OD of drillpipe —.

(5) Force of closed-in fluid at upper end of hose —.

(6) Force of semi-closed-in fluid pressure at bit (pressure drop across bit × ID area of pipe) +.

(7) Reaction effect of jets in bit, includes bit fouling, etc., —.

(8) Torsional stress on drillpipe (none).

(9) Vibratory effects due to critical speeds, kinked pipe, "rough bottom" (usually of some harmonic order + and — damped by other forces). (Depends on circumstances.)

(10) Friction through kelly bushing —.

When off bottom, rotating as slowly as possible without circulation, the author feels that

(1) Is positive and is close to weight of the portion of the load not immersed plus (weight of immersed portion × mean buoyancy factor).

(2) Is zero, having been converted to horsepower loss.

(3), (4), (5), (6) and (7) are zero.

(8) Is a low figure of horsepower into rotary table and has no effect on hook load.

(9) Is zero.

(10) Is zero. No vertical motion is involved.

When off bottom and rotating at drilling speed with the pump at drilling speed,

(1) Is as above.

(2) Is negligible. (See appendix.)

(3), (4), (5), (6) and (7) are of the sign shown and indicate their algebraic sum on the weight indicator.

(8) Has no effect on hook load.

(9) These may show up through the damping effect of wall friction and fluid friction. If so, they are self-measuring and, if serious, are visible at the kelly or audible on the rotary table.

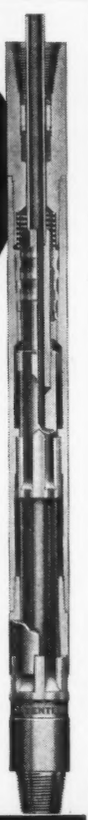
(10) Cancels out unless blocks and hook are swaying, or are of low order if the kelly is running true in the hole and bushings are of anti-friction type. In any case, this force becomes one of the f_n forces under Σf above.

On bottom, just as the bit contacts, all the above factors are automatically measured and give a net compensated reading on the weight indicator instrument. As long as the rotary table turns, Item (2) and (10) remain practically constant and, as long as the pump runs at reasonably the same speed, Items (3) and (7) remain practically constant.

Vibrations caused on the derrick, blocks and pipe by pump pulsation are external vibrations which can be removed by damping the pump, or the instruments, to eliminate them. They are not, it is believed, transmitted to the bit unless they are so large as to be almost dangerous to the surface operations. The "elastic bag" nature of the drillpipe, friction on walls and immersion in fluid should give almost constant fluid flow, at the lower end of a long drillpipe string. In addition, the restriction at the bit jets gives further stablization to the flow rate.

Vibration of cutting action, such as the "washboard effect" of raising and lowering the drill collars each time a rock bit tooth "goes over center," is absorbed in the drilling string, unless the bottom of the hole becomes badly out of level.

Straight Pull Jar Reduces Risk of Twisting off in the Hole



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In view of the above, it is seen that a reading of the hook load becomes one in which all the major forces on the string becomes self-balancing under reasonably steady-state conditions and, it appears, over a relatively wide range of variation forces. The major forces to consider, therefore, become the off-bottom summation, and the on-bottom summation of those factors which cause variations, such as wall friction, mud flow rates, rotary speeds and vibration.

The difference shown on an accurate indicator is, subject to damping out unusual and abnormal forces, very close to the true mean weight on the bit.

Instantaneous bit loads are undoubtedly quite wide in their variations and, if we could obtain a reading of these forces at the surface, it is believed they would have to be damped to about the same order as the surface readings are naturally read, before being usable as a controller signal.

Furthermore, to those who consider bottom hole measurement of bit loads more desirable, the writer wishes to point out that, after damping these signals to usable form, the interpreter, or instrument, has to apply the result to the machinery at the surface in any case. Therefore, if a bottom hole controlled variable was used, the entire elastic string would have to be moved to correct an inelastically obtained reading.

In other words, by using the hook signal and controlling the hook load, the effect of position changes on the string elasticity comes in before pick-up and after controller action and not between them. This reduces time lag between signal, control action, and re-signal. The effect of string elasticity follows, as a natural damping action, and tends to reduce hunting of controllers to a minimum.

TABLE 1. Pickup or primary signal devices* for automatic drilling controls.

Type of signal	Electrical	Pneumatic	Hydraulic
Weight, or load	Resistance strain gauge. Magnetic strain gauge.	Dead line angular displacement —Thrustorq type.	Dead line angular displacement (Martin Decker type).
	Dead line angular displacement against hydraulic or pneumatic device.	Torque arms with null balance against load.	Dead line full load on hydraulic cylinder.
	Torque measuring devices.		Torque arms and null balance against load.
	Null balancing against main drum torque.		
Speed, or feed rate	Tachometer generator	Small compressor discharge against variable orifice. Pressure across orifice is proportional to speed.	Pump discharge against variable orifice. Pressure across orifice is proportional to speed.
		Requires a speed indicator such as an electric tachometer to give true speed.	Requires a speed indicator such as an electric tachometer to give true speed.

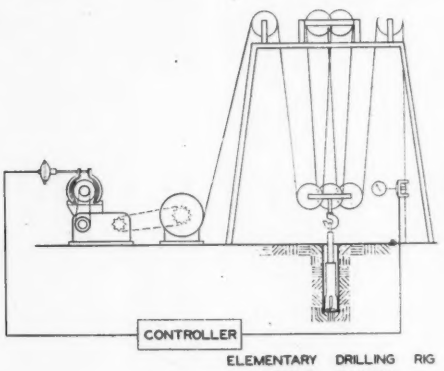
*All devices must be fully temperature compensated, or unaffected by temperature, over operating range.

Elements of Control Systems

(a) *Pickup or measuring devices (primary elements).*

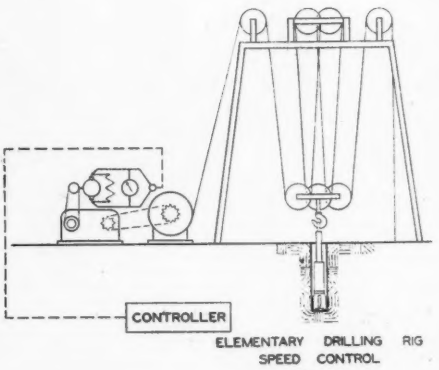
In a drilling controller, an elementary form of which is shown in Fig. 3, a signal, or controlled variable, proportional to the weight carried on the hook is necessary as the input to any weight controller. Such devices may be installed on the dead line and measure hydraulic pressure, as with a Martin Decker weight indicator, by air pressure, extension of a bar, or strain, using magnetic or resistance methods. Summations of strains on derrick legs and cables or any other means of obtaining a pressure or electrically controlled variable proportional to cable load are acceptable. The devices may be used on the live line or drum end, including torque sensitive devices, hydraulically or pneumatically supported torque arms, or hydraulic pumps, the discharge pressure of which is maintained at a set figure to represent torque load. All these devices should be fully compensated for temperature variations caused by operating or atmospheric conditions.

If a speed limiting device is required or incorporated in the control, a second controlled variable, proportional to hook lowering speed, is required. This may be a flyball governor, a tachometer generator, or a hydraulic pump or air compressor from which the output volume is controlled and the output pressure then becomes proportional to the speed of operation or drum RPM.



ELEMENTARY DRILLING RIG WEIGHT CONTROL

FIG. 3



ELEMENTARY DRILLING RIG SPEED CONTROL

FIG. 4

(b) *Time delay or transmission.*

In order to enable controller mechanisms to perform their functions properly, especially at the higher drilling rates, sufficient time must be given for the load signals to reach the controller, actuate it, pass the result to the braking device, and make the motion adjustments necessary to correct the load back to its set point. This delay must also give time for overcoming inertia of the system and bringing the heavy inertia of drilling rig moving parts back through the transmission, blocks and hook to a new speed or weight setting. The final result eventually gets back through this system to the dead line and starts all over again.

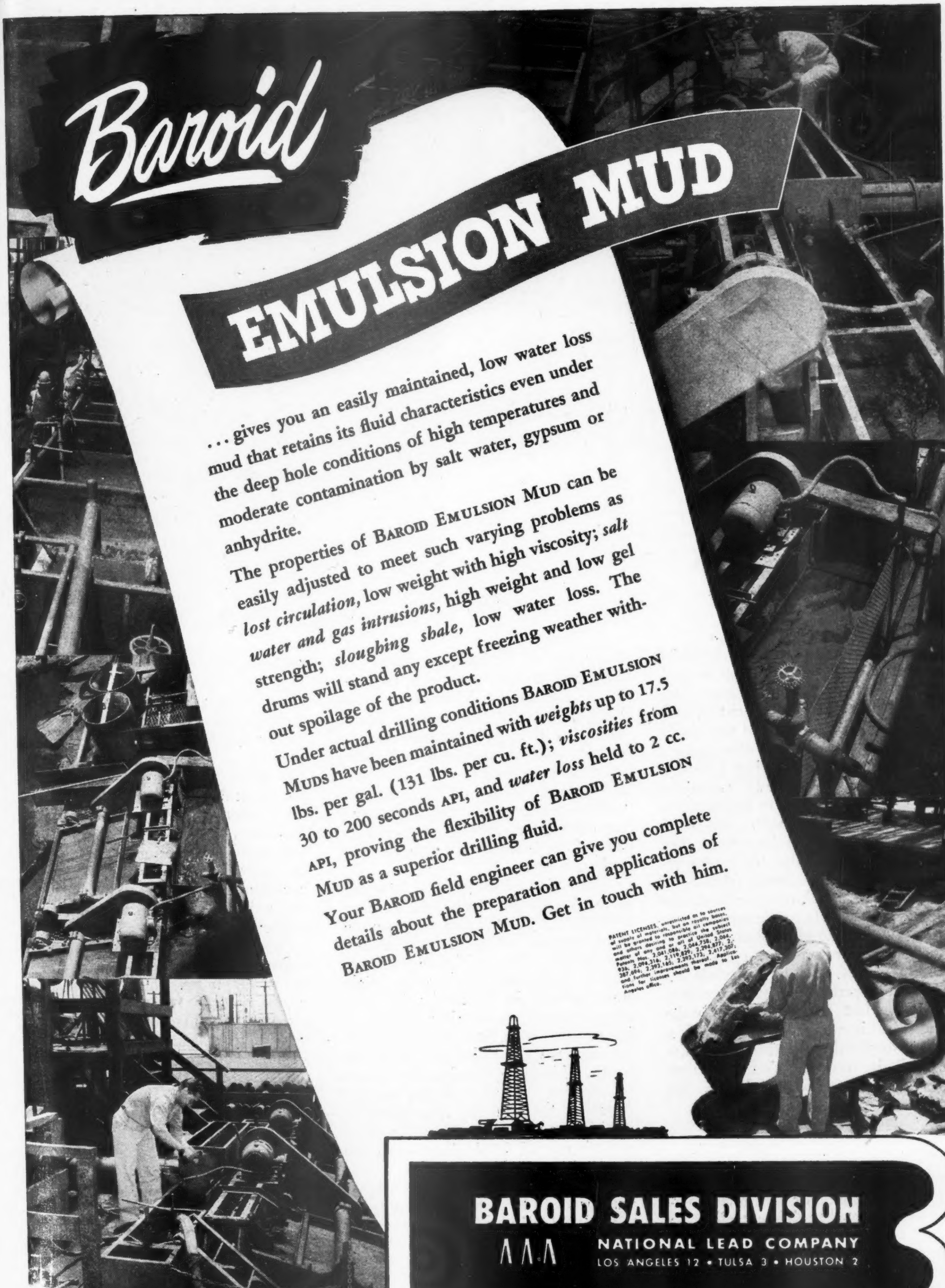
If the time constant of the moving load parts, or that time taken by those parts to accelerate due to a change in load, is less than that of the total cycle time of instrument action, hunting becomes uncontrollable and stability is impossible.

On a drilling rig, it takes a definite time for surface positional changes to travel the length of the drilling string and for the string to adjust itself to its new position. This time depends on the rate of drilling, rotational rate, friction forces and depth of well.

A control system with too fast action would probably wear itself out rapidly by attempts of the controller and brake to adjust to its signal variations. For this reason, a time delay, in the form of a speed increaser from the drumshaft, is highly desirable, if not essential to a good control system. It gives elasticity and flexibility which, under the widely varying operating conditions on an oil well, are essential.

(c) *Brake.*

Any form of brake used, whether electrical, mechanical, pneumatic or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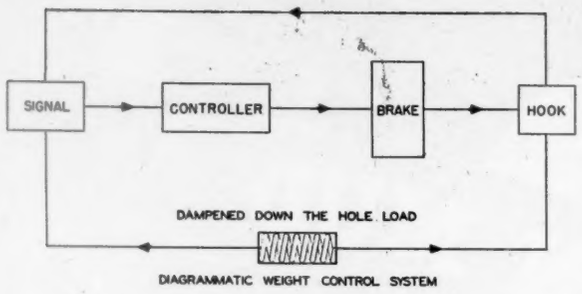
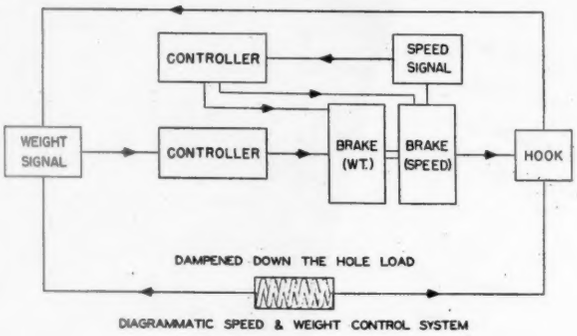


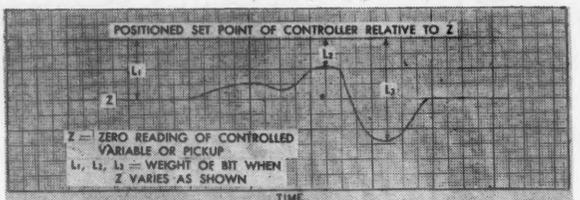
DIAGRAMMATIC WEIGHT CONTROL SYSTEM

FIG. 5



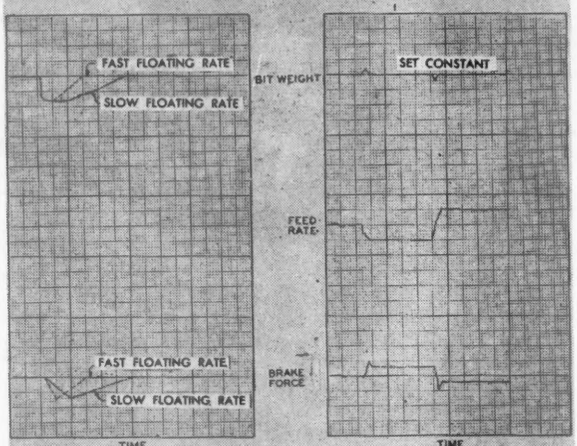
DIAGRAMMATIC SPEED & WEIGHT CONTROL SYSTEM

FIG. 6


POSITIONED SET POINT OF CONTROLLER RELATIVE TO Z
Z = ZERO READING OF CONTROLLED VARIABLE OR PICKUP
L1, L2, L3 = WEIGHT OF BIT WHEN Z VARIES AS SHOWN
TIME

EFFECT OF PICKUP DEVICE ZERO ERROR ON BIT WEIGHT

FIG. 7.



RESPONSE OF PROPORTIONAL SPEED FLOATING CONTROLLER TO SUDDEN CHANGES

RESPONSE OF PROPORTIONAL SPEED FLOATING CONTROLLER TO SUDDENLY APPLIED SUSTAINED CHANGES (FAST FLOATING RATE)

FIG. 8.

hydraulic, must be of a type sensitive to the slightest motion of the controlling mechanism. For this reason, variations in friction characteristics over small ranges of adjustment are highly undesirable. Since the brakes are not of the positive positioning type but should "float on the load," variations of characteristics due to temperature or of friction coefficients, except as noted above, are not important. The exception to this is that the torque required to overcome static friction of the braking mechanism should be kept to an absolute minimum. This is because the brake often shuts the load down to a static position and sudden overcoming of static friction always causes an overrun or hunt. Any eccentricity or lost motion in the brake mechanism is extremely bad in such a case. If mechanical friction brakes are used, it is recommended that they operate oil immersed, to minimize the above problem.

(d) *Control instruments.*

Figs. 5 and 6 show simple diagrammatic forms of drilling control systems. The system may be described as follows. The signal or controlled variable is connected to the controller. As a rule, the transmission lag is of very low order. The controller must have the control point adjustable over a wide range.

Since the brake or retarding device is floating in a delicately balanced condition against the load, a sensitive proportional band adjustment is required in the instrument. This proportional band adjustment is sometimes known as a sensitivity adjustment, and determines the rate at which brake force is applied per unit of controlled variable change. Since drilling rig controllers are close coupled to the braking means, the controller lag, or time taken for a brake response to the controller, is small.

The action of the control is as follows. As the bit drills off, the controlled variable changes and operates the controller which, in turn, releases the brake. The drillpipe position moves downward until the bit weight goes back to its required value and, thus, returns the controlled variable to its original value. At this time it again operates the controller to tighten the brake. This cycle, continually repeated, obtains a balance on the system. Actually, the changes take place so rapidly and proportionally that smooth pay-off is obtained when the system is properly designed.

Due to the wide range of weights and speeds to be controlled, a proportional band adjustment is necessary in the control instrument in order to obtain stability of control at various ranges of set point.

Simple standard forms of instruments, such as pressure controllers, are readily adaptable to drilling controls. In view of the small percentage of instrument reading which is, in reality, being controlled, devices which amplify the magnitude of variations of controlled variables are desirable. The use of ratio type relays or pilots can be used to multiply the output of the controller per unit of change of controlled variable. These devices, however, multiply the controller errors and lost motion, and it is more desirable to multiply the controlled variable changes ahead of the controller if these changes are not already of the required order.

As with any instruments, properly engineered installation and reliable power supply must be furnished. This means that, for example, clean, dry air must be furnished. Instruments may be complex, but the operating adjustments must be simple so that the drilling crews can use them properly.

Horsepower, Range, Sensitivity, and Accuracy

(a) *"Pickup" or primary element.*

This device must be self-operating from the source of power available, i.e., the load. On heavy drilling rigs it should have sufficient capacity to transmit the maximum load expected, without rupture—usually involving impact loads on cables much heavier than the normal loads. For instance, a cable operated device should be capa-

NAVARRO SAND
IN CHARLOTTE FIELD
ATASCOSA COUNTY, TEXAS

Mud (Water & Clay): R_m = 1.00 ohm at BHT
Bit size: 7⅞"
Spacings: AM = 16"
AM' = 63"
AO = 24'

This is the third in a series of interpreted electrical logs from identified formations and fields which Schlumberger will reproduce in this publication. If you would like to keep this entire series, please write to us on your letterhead and we will be glad to send you a reprint of this log (and preceding logs in this series) with a binder in which you may file subsequent logs as they are published. This series is made possible through the courtesy and cooperation of the oil operators who have released these logs.

3

LOG ANALYSIS

1) Water saturation S

This sand is relatively clean in the first 15' and is found highly interbedded with shale below the upper section.

The value of 8 ohms at level A given by the 63" Normal when corrected will result in R_t = 12 ohms approximately.

R_o = 2 ohms in neighboring wells.

In A: $S = \sqrt{\frac{2}{12}} = 41\%$

2) Formation water resistivity R_w

With $SP = -70 \log_{10} \frac{R_m}{R_w}$ and SP = –65 mv.,
R_w = 0.12 at BHT

3) Porosity p

$F = \frac{R_o}{R_w} = \frac{2}{0.12} = 16.5$ approx.

$p = \sqrt[m]{\frac{1}{F}} = 17\%$ for m = 1.6

CORE ANALYSIS

Average Porosity	18%
Permeability: Average	15 md.
Maximum	113 md.
Residual Oil	14%

PRODUCTION RESULTS

Casing at:	5193'
Plug Back:	5234'
Production Potential:	140 bbl. oil 39° API 26.5 MCF gas Gas-oil ratio 189/1

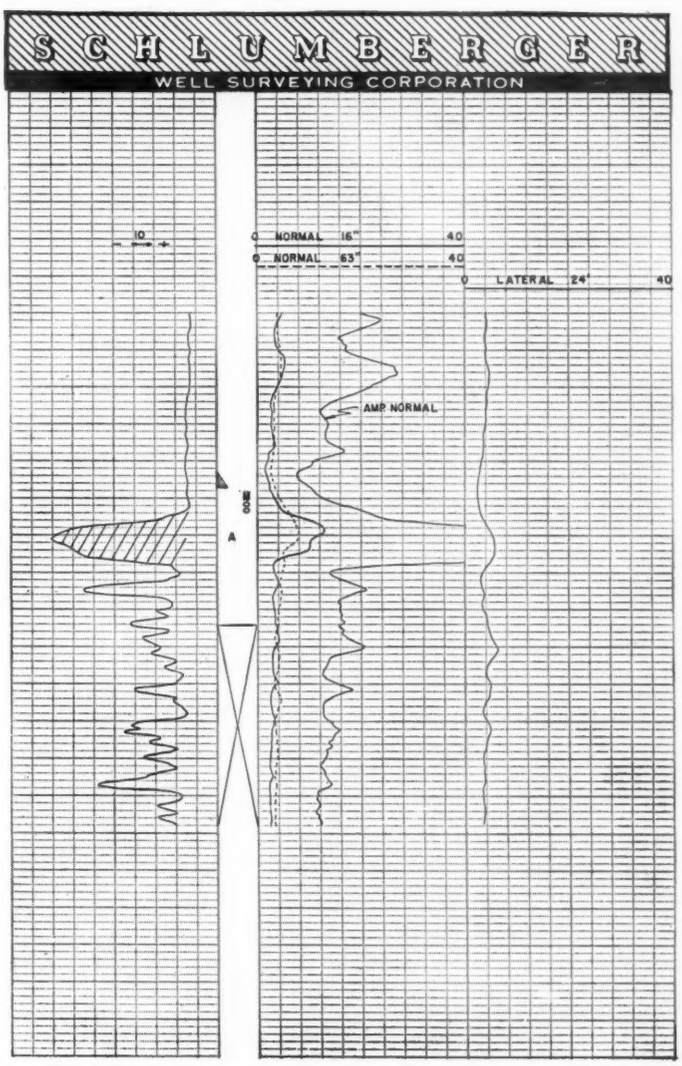


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TABLE 2. Controller types for drilling controls.

	Electrical	Pneumatic	Hydraulic
Weight	For use with electric brakes Null balance control of armature current of brake motor. Null balance control of field current of eddy current brake. Electronic controls give highest speed of operation, great great flexibility.	Pressure controller, using motor valve to operate brake. Signal from weight devices, Table 1. With floating proportional band adjustment. Fast and flexible operation.	Hydraulic pressure controller with brake operating motor. may employ signal from any source, Table 1. Faster but less flexible than pneumatic. Requires special damping.
Speed	With electric brakes. Control of field voltage of brake motor from tachometer generator signal. Control of eddy current brake field from tachometer generator signal. Superimposed on, or in series with, weight control.	Pressure controller as above, with motor valve to operate brake. Signal from hydraulic or pneumatic devices, Table 1.	Pressure controller similar to above, with motor valve to operate brake. Signal from any source, Table 1.

TABLE 3. Types of brakes for automaitc drilling controls.

Electrical	Pneumatic	Hydraulic	Mechanical
Motor balanced against torque load. Can be over-excited to raise load. Eddy current brake.	Air compressor operated against variable orifice. Air pressure on pistons holds load. Controller operates motor valve on discharge of compressor. on discharge of compressor.	Oil pump operated against variable orifice to control pump pressure. Flue pressure on pistons holds load. Controller operates valve on discharge of pump.	Precision friction brakes, preferably oil immersed. Brake applied by motor valve, hydraulically or pneumatically operated.
Balanced torque arm type with motor to drive feed gear train.	Balanced torque arm, with air motors to drive feed gear train	Balanced torque arm, with fluid bleed to lower load—dual brakes used (Kinzbach). Hydraulic variable speed transmission using constant torque, variable stroke pump. Speed governs stroke. Weight governs pressure.	

ble of having the cable broken without causing mechanical failure or, if possible, without permanently affecting calibration of the device.

On rigs using eight lines and for hook loads up to 360,000 lb, the operating load range may be assumed to be about 30,000 to 360,000 lb which is, neglecting friction, from 3750 to 45,000 lb on the dead line cable. Pulls up to cable braking strength need not register.

The device should have a minimum accuracy over full operating scale of ± 1 per cent and, when the load is full floating, or subjected to rig operating vibrations, should have a sensitivity, or be able to transmit changes in hook load, of 150 lb or less. This is about one part in 2500 or 0.04 of 1 per cent.

(b) *Controller.*

The controller should be of a precision type and, for general oilfield use, should not incorporate copper or brass moving parts which are affected by sulphur gases. Stainless parts are most desirable, but such parts as are necessarily of corrodible nature should be protected by coatings capable of outdoor exposure in oilfield vapor.

Temperatures of from 150 F in the sun to —50 F in the winter should not affect instrument operation at any given set point, providing proper "winter" or "summer" treatment of the instrument is specified and used. Air supply, particularly, should be properly dried so that freezing of pneumatic operated parts will not take place in winter.

The control system, as a unit, must be able to recognize the change of 1:2500 from setting point which the primary element shows and cause the corresponding correction force to be applied to the brake. Since, as described before, the whole system is delicately balanced, this presents no serious problem with standard precision equipment because, in the delicate state of balance, the slightest change in opposing force causes a change in braking force. In case of pneumatically operated systems, the value which operates the brake has to move only a few thousandths of an inch to change the force materially. Brake force change, therefore, involves practically no increased air volume space to be filled. Compression volume is practically the whole required instrument output.

On hydraulically operated mechanical brakes, the above is a detriment and can cause violent hunting unless a cushion chamber or other damping device is incorporated to smooth out change in the rigid hydraulic operating medium.

The range of instruments will depend on the value and type of signal from the primary element and, also, the medium and value thereof, used for transmitting the controller output to the brake. A wide control point setting range, of about 12:1, is desirable.

Accurate knowledge and specification of the problem are always essential and will enable proper design and selection of instruments to be made.

(c) *Brake.*

The brake may be of various types —electric, hydraulic, mechanical or pneumatic.

In regard to capacity, it may be assumed that any feed-off device should be capable of feeding at the maximum drilling rate expected in the area to be drilled. In hard rock territory, a speed range of from 0-60 ft per hour would cover all except very soft formations. In soft drilling territory, a rate of at least 0-120 ft per hour should be covered by the controller. A recent paper* by Nolley, Cannon and Ragland indicates that a maximum speed of 300 ft per hour may be necessary to obtain maximum drilling rates with drag bits. This would raise the speed or control range to 1200:1 instead of 480:1. In order to attain this range, it is probable that brakes should have two ranges of speed—say, 0-60 ft per hour for "hard rock drilling" and 0-300 ft per hour for drag bits. This, in the same unit, would probably mean a mechanical speed change and the brake would absorb about three times the horsepower at the high operating speed. The load to be handled, and consequently the horsepower to be absorbed, depends on the hook load. On ultra heavy rigs, the maximum drillpipe hook load may reach 350,000 lb and the horsepower, at 100 per cent efficiency and 120 ft per hour, would be 21.22 hp. A light rig for 6000 ft drilling with 4½-in. drillpipe should be able to handle 125,000 lb on the hook, or 7.58 hp at 120 ft per hour.

The brake and cooling system must be capable of radiating or absorbing the heat equivalent of the above horsepower.

In order to obtain sensitive and proportional effect to the action of the controller, the brake must be of an accurate precision type. All eccentricity or inaccuracy will tend to cause poor brake operation.

On mechanical brakes, up to the present time, speed increasers of about 800:1 ratio have been used between the drum and brake shaft but, with development of proper controls, it is believed this can be reduced to half this ratio. Until it can be reduced to about 300:1, however, at least a quadruple reduction transmission from the drumshaft to the brake will be required. These transmissions provide the time lag between the drum

*"The Relation of Nozzle Fluid Velocity to Rate of Penetration with Drag Type Rotary Bits," Spring meeting API, San Antonio, April 10, 1948.

and the brake to give instruments time to operate and control.

(d) *Causes of errors.*

In the mechanical transmission, friction should be kept to a minimum. This is largely because, once the brake stops, quite a difference in hook loading, perhaps 1000 lb on a poor brake, is required to overcome static friction which becomes horsepower loss when running. At any given rate of feed-off, or weight carried, within reasonable range, friction horsepower loss represents part of the energy which it is desired to dissipate and has little effect on the weight of the hook. The weight or speed controller reads the result from the hook load and applies the brake controlling force to destroy part of the falling energy. The more friction horsepower loss there is in the gear system, the less work there is for the brake to perform.

In control circuits, lost motion, leakage, false settings or inaccurate instruments and controllers will cause errors. Fortunately, however, the control point is hand-set to a given visible indicator or gauge point and, if the pickup device signal remains stable, and the instrument-brake combination does not hunt, the hook load will be maintained within close limits.

An error takes place in all weight control systems which use either the dead line or torque from the live end, or drum end, as the point from which the weight signal is obtained. This is the weight of drilling cable added into the block lines as the kelly is lowered. On feeding down a 30-ft joint of drill-pipe with eight lines, with the cable weighing 1 lb per foot, there are 240 ft or 240 lb of extra load supported by the cables when the joint is "down." This has the effect of adding this amount of weight to the bit at the lowest portion of the kelly. A device to adjust the instrument control point setting in proportion to the number of feet of line added would compensate for this error.

The only method of removing the above error from the picture is to take the pickup signal from below the traveling block. This has been done, but adds complexities of having cables or hoses suspended in the derrick with means for keeping these connecting lines taut and preventing them from fouling the cables on the block.

When mud weights or characteristics change materially while drilling down slowly, a change in the self-balancing of the system will take place. In such cases, picking up of the drill-pipe to check off bottom weight will determine the amount of change and resetting of bit weight necessary. * *

Part 2 will be published soon.

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EXCLUSIVE

New "Selective" Cross-Over Packer

TEMPLE P. HOFFER*

VERY often during the flowing life of dually completed wells, it becomes necessary to switch or cross over the flows from the zones after the well is placed on production. In some wells producing with a single packer between the formations, quite often the upper pay ceases to flow through the tubing-casing annulus, when it appears that the lower formation would flow through the casing and the upper zone up the tubing. Also in some cases, operators have anticipated that cross-over packers might be required to best-produce the zones, but have discovered after flowing the zones that it would be advisable not to produce in the crossed-over manner but instead to produce the well by flowing the upper zone up the casing and the lower zone up the tubing. In the past, switching the flow courses in two-zone wells has necessitated killing the well and round-tripping the tubing string. This involves time, considerable expense, and also the possibility of damaging producing formations with mud or water.

Recently, a new type of cross-over packer introduced and successfully used offers distinct operating advantages and flexibility not previously available in cross-over equipment. To cross over the flows or to change from a cross-over flow back to a conventional flow is quickly and positively accomplished by use of a wire line on which is landed two types of wire line chokes in this new "selective" cross-over packer. Because this selection of flows is possible by use of a wire line, the expense of killing wells and pulling and running tubing is unnecessary.

The selective cross-over tool, Fig. 1, is an anchor style (no slips) packer that is equipped with an upper and lower-opposed pressure sealing element. These elements are molded from non-vulcanizing synthetic rubber and reinforced internally with plastic ducking. The packing elements, with diameters pre-sized to pack-off any pressure, are mounted on the main body of the packer that has internal passages to conduct the upper formation production up the tubing or tubing-casing annulus, depending upon the flow arrangement the operator desires. Above the packing elements, the body of the packer is extended and has incorporated a landing nipple and locking recess to accept one of the two types of wire line chokes furnished as a part of the selective cross-over packer. One of these chokes, Fig. 2, may be considered the equivalent of a commonly used side-door choke, and the other, Fig. 3, is a slightly modified form of the side-door choke. To show the internal construction of the tool better, Fig. 4 illustrates a cut-away view of the landing nipple with the cross-over type choke locked in place. It will be noted that the crossing over of the two flows is accomplished by use of this type choke. In Fig. 5 is shown the side-door choke in place, and in this arrangement separation of the well's fluids is maintained, yet the flows are parallel.

FIG. 1. Center, selective cross-over packer.

FIG. 2. Left, regular flow choke.

FIG. 3. Cross-over choke.

The selective cross-over packer is run in the tubing string above a regular hook-wall packer that is required between the zones. Sufficient tubing is placed between the lower packer and the cross-over packer to cause the selective cross-over packer to be landed above the upper zone perforation. When running the tubing string, it is considered good practice not to have a choke in the selective cross-over packer. The selective cross-over packer is constructed so as not to interfere with setting the lower packer, and because this packer has no slips and uses pressure sealing elements, the selective cross-over packer requires no manipulation of the tubing string to set it.

With the lower packer set, the tubing landed, and surface connections made up, the upper and lower zones are brought in together. With the zones flowing through both the tubing and the casing, the operator selects the type of choke to produce the well as desired. If the lower zone is to be produced straight up the tubing and the upper zone up the casing, the type

*Petroleum engineer, Otis Pressure Control, Inc.

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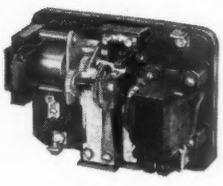
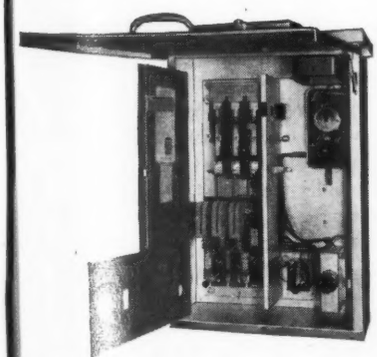


With a **G-E time-delay relay**, pump motors are not started all at once, but in succession, to prevent excessive voltage drop.



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661-3

of choke shown in Fig. 2 and noted "Regular Flow" is run on a steel measuring line and locked in the selective cross-over packer.

If it appears advantageous to produce the upper zone through the tubing and the lower formation through the casing, the choke shown in Fig. 3 and noted "Crossed-Over" is selected. The arrows in Figs. 3 and 4 show the course of the gas or fluid through the selective packer. In the cross-over type choke, two spring-loaded equalizing valves are used to facilitate running and pulling the choke.

Thus, this equipment makes possible the production of a dually-completed well in the conventional or crossed-over manner by using either of two types of wire line chokes. It is no longer necessary to kill wells and pull tubing when it is desired to cross-over.

Further, because communication is established between tubing and casing and zones when either of the chokes is removed by wire line from the selective cross-over packer, this equipment affords many of the advantages offered by use of standard side-door chokes. It will also be noted that it is possible to close in one of the zones to take bottom hole pressures, etc., while producing the other zone.

To date, a number of the selective cross-over packers have been successfully installed and operated in dually-completed wells in Texas and Oklahoma. Because of the distinct and new operating advantages offered by the new tool, a greater number of installations are anticipated. * * *

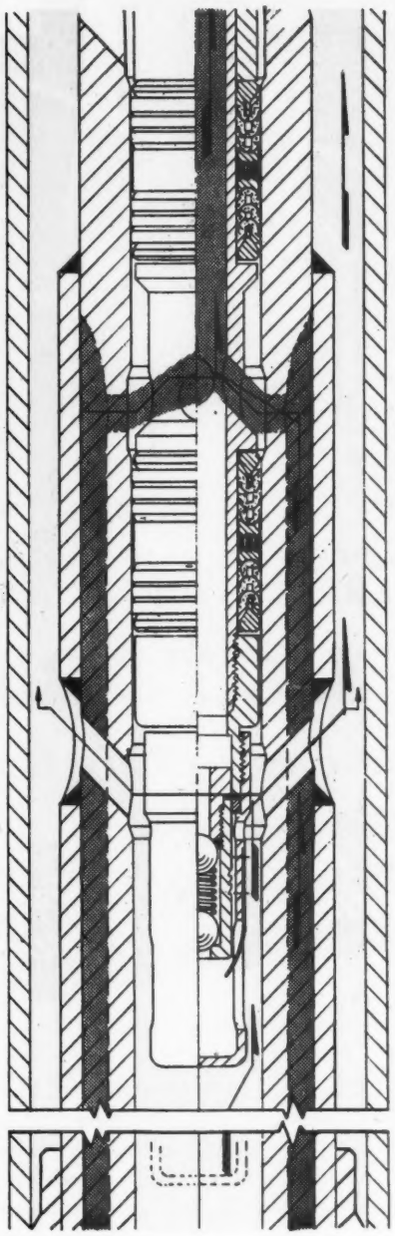

FIG. 4. Crossed-over flow courses.

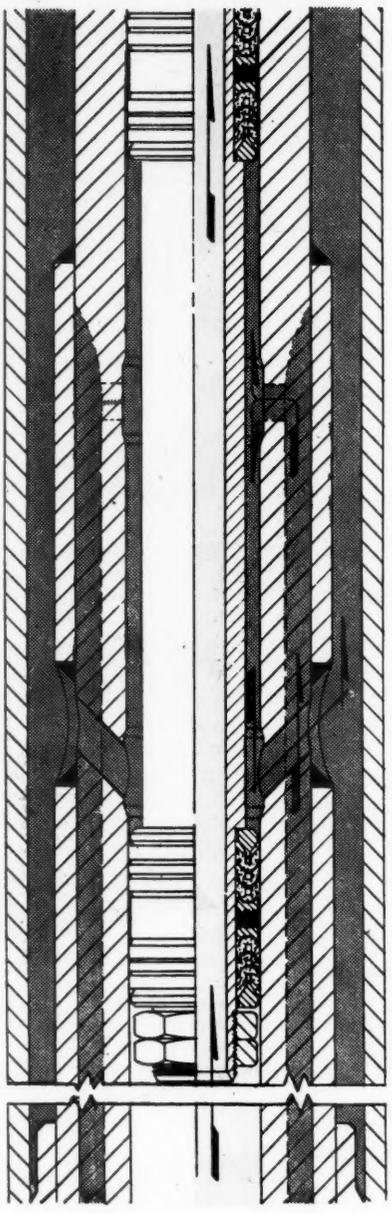

FIG. 5. Regular flow.

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Worldwide Exploration Progress*

F. G. BAILEY

THE search for oil in southern France in recent years has resulted in the discovery of substantial gas production and a small output of oil. In the Belgian Congo, an application was made that delineated a diamond bearing pipe, its presence but not its position being known from geological considerations. These are advances in two countries that have reported gains in geology and geophysics in recent years.

The older Gabian production production is almost exhausted. Possible source rocks include the basal Oligocene and perhaps the Upper Eocene, the Cretaceous, Middle Jurassic, Lias and Lower Permian, the Middle and Upper Cretaceous, and the Lower Permian are the most likely sources. Geophysical and geological work and drilling have thrown new light on the stratigraphy and tectonics of this region. There is evidence of the former existence of an ancient cordillera north of the Pyrenean front.

Anadarko Basin

In August, 1947, a well near the axis of the Anadarko basin in Oklahoma, was abandoned at a depth of 17,823 ft. Speaking before the Internatonal Congress on the "Significance of the World's Deepest Well Bore" R. R. Wheeler (USA), remarked that thick sands were expected, but not found in the Lower Pennsylvanian. There were some evidences of oil at 8200 ft but a drill stem test was inconclusive. Thirty five hundred feet of Deese beds were found resting unconformably on Atoka limestones and sandstones, affording confirmatory evidence that the Arbuckle-Wichita orogenic movements were initiated in early Pennsylvanian times and culminated in post-Atoka pre-Des Doines time, i.e., at a later date than has long been assumed.

A lateral shift of the structural axis at depth was indicated, a phenomenon that was considered in general terms in the following paper by H. R. Tainsh on "An Aid to the Forecasting of Underground Structures." Tainsh made a plea for the compilation of geological cross-sections from surface and subsurface data on structures showing strong dips, because these would probably be of value in guiding deep exploration on previously unexplored structures, and would provide material for the detailed analysis of folding, especially in incompetent beds.

Petroleum Migration

W. B. Wilson (USA) who gave a paper on "Some Aspects of Petroleum Migration," contended that a flattening of the dip of the formations was not sufficient in itself to give a commercial oil accumulation. He believed that oil migrated at an early date. At times this migration might have been before structural traps were formed. Stratigraphic traps might have been available, however. A series of papers on the Middle East and nearby areas, was also before the Geological Congress. G. M. Lee outlined the principal features of the main area in a paper on "Some Structural and Stratigraphic Aspects of the Oil Fields of the Middle East." Sediments from Cambrian to the Tertiary showing no marked discordance are present in this region. From the Permian onward, Sedimentation was fairly continuous and dominantly calcareous. The rocks change in detail towards the Arabian foreland, the chief difference between this and the Iranian area being the absence of a great thickness of Tertiary in the former. Strong structures occur in the Iran and Iraq oilfield areas, and to the northeast, but towards the Arabian shield dips are generally less than 3 or 4 deg.

Iran and Iraq

In Iran and Iraq the first big barrier to upward migration of oil is the Lower Fars series, and oil production has been obtained from the immediately underlying Asmari and Main Limestone series, respectively, in these two countries. Many possibilities exist with regard to source rocks—Asmari, Eocene, Upper, Middle and Lower Cretaceous, Jurassic, Triassic, and even Cambrian rocks—and there are vertical fissure connections with the reservoir rocks. Live oil noted in some Cretaceous cores may be in process of upward migration.

Towards the Arabian foreland there are considerable developments of anhydrites that can act as cap-rocks. The source of the oil is not settled, but there is oil in the Jurassic and Cretaceous.

In the Iran oilfield area are anticlines as much as 200 to 250 miles long. The incompetence of the Fars series has given rise to extreme disharmony between the surface and deeper structures. Surface snyclines have been found over subsurface anticlines.

The salt dome structures of Iran are subsidiary to the main folds among which they are found. Intrusion of salt began in Upper Cretaceous time before the fold pattern was developed. There are dead salt plugs that have apparently exhausted the parent salt bed, and active plugs that seem to be in a kind of hydrostatic equilibrium with the enclosing sediments.

Reservoir Rock

In a paper on "The Asmari Limestone of Southwest Iran," A. N. Thomas discussed laterally variation and correlation in the Asmari, the reservoir rock giving the bulk of Iran's oil production. He concluded that, in the wide sense, the term Asmari Limestone formation should include the underlying Brissopsis Beds, the Kalhur limestone of the Khanaquin district (equivalent to the upper part of the type section) and probably also the Khamir Limestone. Some parts of the Asmari were deposited under conditions believed to be favorable for oil formation, and it was considered that the Asmari oil might therefore be indigenous.

Limestone Reefs

The following paper by F. R. S. Henson was on "The stratigraphy of the main producing limestone of the Kirkuk oilfield." A description of the general pattern of typical Middle East reef complexes was given, and the petrological and physical characteristics of the main parts, together with the environment of formation, were described. Clues to the stratigraphic history of the area are provided by the successive positions of corresponding parts of the reef complex. A stratigraphic break immediately above the reservoir over much of the Kirkuk structure was considered to afford evi-

*Mr. Bailey of London has based his discussion on papers given before the eighteenth session of the International Geological Congress, August 26, 27, 31, 1948, at the Royal School of Mines, London, England.

dence on the time of oil accumulation and on the age of the oil source rock.

Influence of Salt Beds

The structural complexities of the Iranian oilfield belt, noted by Lees, formed the basis of a paper by C. A. E. O'Brian on "Tectonic problems of the oilfield belt of southwest Iran." O'Brien considers that the salt-laden Lower Fars Series constitutes a mobile group between competent pre-Fars beds, and incompetent Fars-Bakhtiari deposits, and is largely responsible for the extraordinary structural differences between the Asmari limestone and the surface beds.

Orogenic movements are believed to have formed great anticlinal structures in competent pre-Fars beds, and the overlying plastic series is thought to have reacted in close conformity with the laws of hydrostatics leading to the flow of salt from high pressure areas over rising anticlines into adjacent synclinal areas.

E. R. Gee's paper on "Petroleum Geology in Pakistan," was presented by H. Crookshank. This paper dealt chiefly with Western Pakistan, and summarized the geological history and stratigraphy. A brief account of the oil exploration and exploitation was included.

In a paper on "The stratigraphy of Alexandretta Gulf basin," C. E. Tasman (Turkey) noted that in the basin and adjacent uplands are some 30,000 ft of sediments ranging in age from Silurian to Quaternary. Quartzites and dolomites topped by carboniferous shales represent the Palaeozoic, but the Mesozoic is marked principally by limestones. The Tertiary, which accounts for two-thirds of the total sequence, and is mostly Miocene, contains shales, sandstones, and conglomerates of neritic and continental origin.

The foregoing group of papers provoked considerable discussion. J. L. Rich expressed doubt about the feasibility of the mechanism involved in the tectogene concept. L. G. Weeks contended that there were many prolific oil-bearing basins in which bituminous oil-smelling strata were absent or of minor importance, however, other basins had large amounts of highly bituminous strata with no oil. He believed that source and reservoir rocks could be contemporaneous, and that the presence of a stratigraphic break immediately above the reservoir rock was not always conclusive evidence against such a possibility.

W. L. F. Nuttall drew attention to a break and reef condtion in the "Golden Lane" of Mexico comparable with Kirkuk. Lees noted that stratigraphic traps might occur in this rgion, but that all discoveries had been accumulations due to anticlinal conditions.

Ganso Azul Field

A paper on "The Oilfield of Ganso Azul, Peruvian Amazonas Region" was presented by A. Heim (Switzerland). It was followed by one on "Some Outlines on the Tectonics of the Upper Amazon Embayment" by W. Ruegg and D. Fyfe (Peru), which was read by D. J. V. Harrison. The dome on which the Ganso Azul field has been developed was first observed from the air.

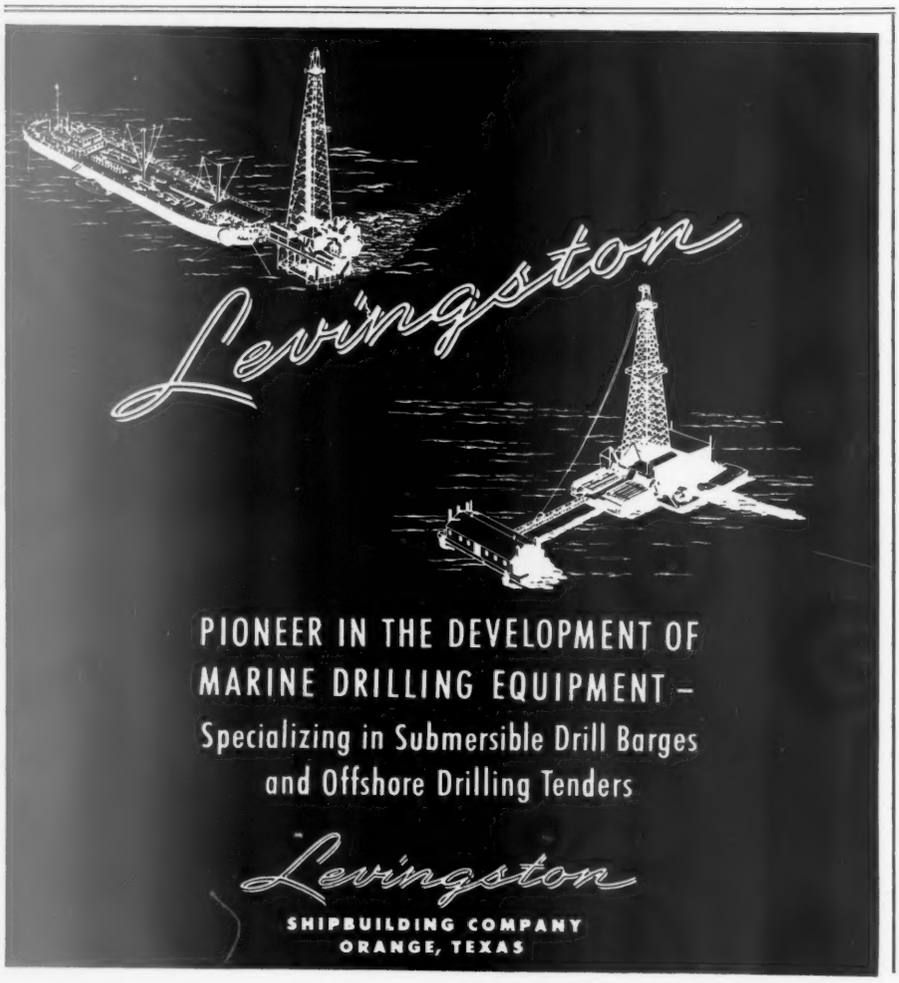
Light oil is obtained from the Cretaceous at depths of about 1000 ft. Permian beds occur below the Cretaceous. Ruegg and Fyfe also noted the large stratigraphic gap underneath the Lower Cretaceous, and pointed out that both conformable and angular contacts were known. Differences in ages, mobility, and position of the individual structural blocks of this region were postulated to explain this feature.

Atlantic Coastal Plain

In their paper on "The Atlantic Coastal Plain," read by R. R. Wheeler, H. W. Straley and H. G. Richards (USA), reviewed the stratigraphy of the coastal plain between New Jersey and Florida. Numerous deep water and oil wells have provided new information on this area. The authors concluded that the oil possibilities of the coastal plain cannot yet be said to have been adequately tested, and they suggested that the Berlin-Salisbury embayment in Maryland, the Pamlico Sound basin in North Carolina, the Beaufort basin in South Carolina, the Okefeeoke basin in southeastern Georgia and northeastern Florida merit further testing. In discussing Straley and Richard's paper, R. B. Campbell remarked that the Cape Hatteras well (North Carolina) revealed a marine section regarded as favorable for oil occurrence. Palaeozoic formations, predominantly black shales, had been discovered beneath the Mesozoic and Tertiary in the Florida-Georgia region, thus revealing the southeastern margin of the ancient land mass of "Appalachia," which hitherto had been regarded by many as lying far out in the Atlantic.

Aerial Geology

A paper was given by T. D. Weatherhead on "Air Survey and Geology." After enumerating the types of information and the advantages that can be obtained by the use of aerial photography, Weatherhead described



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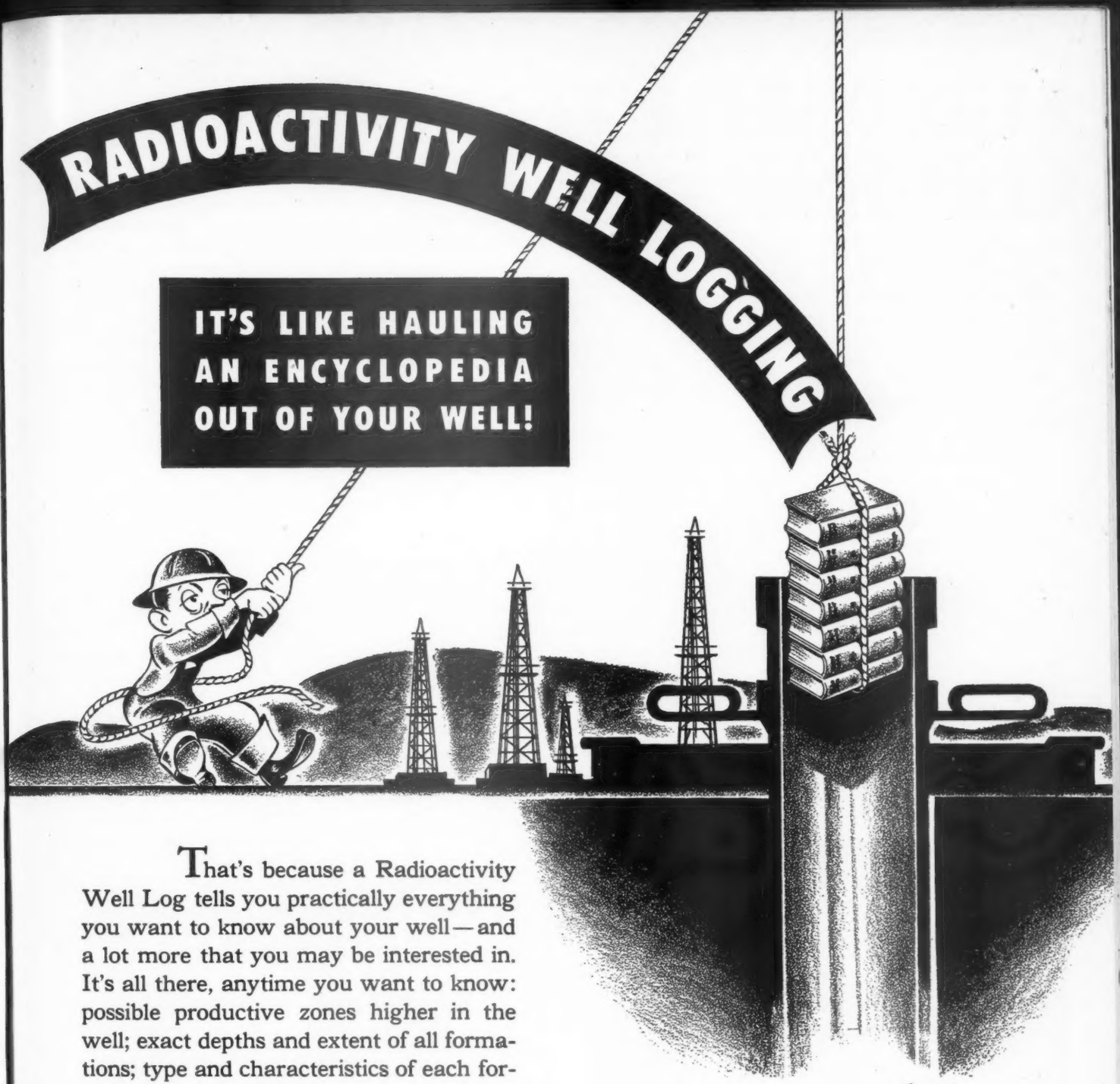

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the types of aircraft employed and the equipment used in photographic flights. The most suitable photographic scales for various purposes were indicated, after which a description of the production of maps with and without contours was given. An account of plotting instruments and slotted-template techniques followed, and the need for ground control was stressed. Stereoscopy for obtaining geological information from the photographs was discussed briefly, and the application of aerial photography and photogrammetry to aerial magnetometer surveys was noted.

Resistivity Surveys

During the first session on applied geophysics, four papers were devoted to resistivity surveys. The important problem of water location was treated by J. J. Breusse and G. Castany. The former was able to distinguish between fresh and saline waters on the Dakar Peninsula, and the later described the location of buried faults in Tunis, the faults controlling locally the accumulation of water. The last resistivity survey, discussed by L. S. Palmer, was to determine the chalk contours below recent deposits in the Holderness, and it illustrated some of the interpretational difficulties arising from the variability of geological formations.

In his description of a potential drop ratio survey, A. A. T. Metzger suggested a modification of the normal method of plotting the results, a modification which, in the example discussed, appeared to have diagnostic value.

Considerable interest was shown in the telluric method discussed by L. Migaux who demonstrated in two cases, that this method, coupled with resistivity observations, gave a clearer picture of underground conditions than the gravity method.

Seismic Surveys

The seismic investigations ranged from deductions made from near earthquakes, through normal reflection methods to small scale studies. F. Montandon illustrated, in the N. W. Alps, the close relation between zones of frequent and intense shocks and regions with numerous and large faults and dislocations, the latter showing previous seismic activity. The fortunate relation between the focus of the earthquake of January 25, 1946, in Switzerland, and four recording stations, allowed N. Oulianoff to examine the crustal structure there and to suggest a tectonic relationship between the massifs of Mont Blanc and the Vosges and those of the Aar and the Black Forest. Seismic reflection methods, used by O. Heerman in the N. W. German Permian Basin, have resulted in a better appreciation of the growth and structure of saltdomes there, while, on a still smaller scale, O. Vecchia described many successful dam site surveys in Italy using the refraction technique.

Gravity Surveys

V. E. Barnes described the first successful gravity survey leading to the discovery of a lead-zinc deposit. The small anomalies here contrasted with those in Wales and the Borders discussed by Thirlaway. The lack of isostatic compensation in the Mid-Wales Plateau and the existence of large faults near Worcester was shown. An interesting torsion balance survey over the Warburton Fault, Cheshire, concluded the contributions on this aspect. The two final papers involved the coordinated interpretation of several surveys in the same area. The area between the Saone and the Rhone was discussed by J. Goguel in the light of gravity, telluric, and resistivity surveys. A. Bentz described the magnetic, gravity, and seismic refraction maps of northwest Germany and their geological significance. * * *

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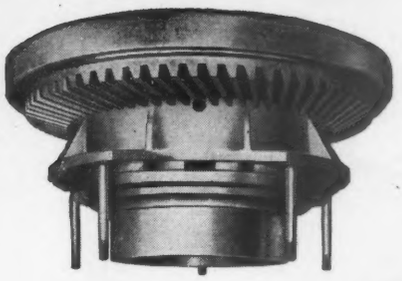

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NEWS

Drilling to Begin Between Saudi Arabia and Kuwait

James MacPherson, vice-president and general manager of the American Independent Oil Company in charge of operations in Kuwait, has departed by air from New York for the Persian Gulf where upon arrival the actual drilling for oil will be commenced in the Neutral Zone between Saudi Arabia and Kuwait, that area directly south of the world famous Burghan oil field, Ralph K. Davies, president of the company, announced.

"Drilling should begin," Davies indicated, "early in December, shortly after the arrival in the Gulf of the *M/V Aminoil*. This motor vessel, a converted LST, with complete drilling equipment aboard and supplies for the first year's requirements, departed for Kuwait on October 1 from Orange, Texas. After being unloaded it will serve as a floating hotel and operations base.

"The actual drilling operations in Kuwait as well as the company's contracts in Mexico with Pemex, the Mexican Government oil authority," Davies stated, "have required not only the expansion but also the consolidation of our activities 'on location' both in Kuwait and Mexico. Accordingly, those activities, which for the past two organizational years have been coordinated by Aminoil's Washington, D. C., office henceforth will be transferred to the operational offices in Kuwait and Mexico or to the company's headquarters in San Francisco."

The Washington office, which has been headed by Charles Rayner, will be officially closed on December 31, 1949.

Tulsa Will Be Host to Drilling Contractors

Tulsa, Oklahoma has been selected as host city for the tenth annual meeting of American Association of Oilwell Drilling Contractors, and the dates of October 9 and 10, 1950 have been set, according to an announcement by Warren S. Churchill, president. This action was taken by the Association's board of directors at a special meeting in Chicago, November 8, where it was suggested standing committees of the Association should meet on October 7 and 8, preceding the annual convention, so that more complete reports on Association activities could be made and a greater amount of work accomplished.

J. Ed Warren of Midland, Texas, (left) the new president of the Independent Petroleum Association of America, discusses some of the Association's problems with the past president, Fred Shield of San Antonio.

Annual Secondary Recovery Conference in Pennsylvania

More than 150 oil producers and engineers attending the 13th annual Secondary Recovery Conference at State College, Pennsylvania, heard a report that experimental use of gas in conjunction with a water flood increased oil recovery as much as 20 per cent in the laboratory.

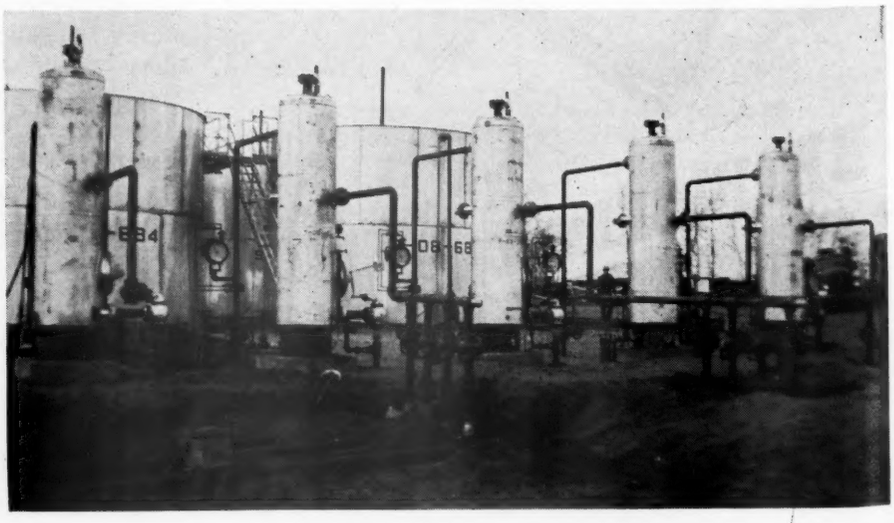
Louis Schiffman of the Bradford, Pennsylvania, laboratory of the Pennsylvania Grade Crude Oil Association, reported these results in a paper he prepared with Dr. J. N. Breston, laboratory chief. The experiments on long oil sand cores, Schiffman said, showed use of gas before and during a water flood operation proved "highly desirable, being of definite economic advantage and a conservation method."

Morris Muskat of Pittsburgh, chief of Gulf Research and Development Corporation's physics division, told the oil men that advances made in oil recovery during the last decade or two have resulted from research in field and laboratory, leading to understanding of the physical processes by which oil is produced.

C. B. Dale of the Association's Bradford laboratory gave a paper, which he wrote with Robert Macfarlane and Dr. R. V. Hughes, showing that effect of pore size of the oil sand alone on oil recoverable by flooding was small.

Other speakers were: David L. Evans, Robert C. Neal, R. F. Nielsen, George V. Keller, J. H. Henderson, J. C. Griffiths, and W. E. Eckard.

Battery of separators under construction to serve 16 flowing wells in Redwater field, Canada. —*Photo by J. E. Baugh.*



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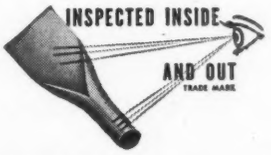

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Describes Gas-Lift Project

A bulletin by S. F. Shaw, entitled "Flow Characteristics of Gas Lift in Oil Production" has been published by the Agricultural and Mechanical College of Texas. The air lift research project described in the bulletin was made for the purpose of determining the productive capacities of four diameters of flow pipe of various lengths when lifting water and oil by means of air lift.

The bulletin may be obtained from Texas Engineering Experiment Station, A. & M. College of Texas, College Station, Texas.

Shell Sets Up New Lab

Shell Oil Company has set up a new production laboratory to determine the characteristics and the contents of reservoir rocks. The laboratory is situated at 5014 E. Admiral Place in Tulsa, Oklahoma.

The new laboratory will be devoted to the analysis of cores and drill cuttings, porosity, permeability, oil and water saturation, solubility and capillary pressure characteristics.

R. F. Smith is supervisor of the laboratory, and will work with a staff of seven technicians. The organization will serve the exploration and production staff in the entire Tulsa area.

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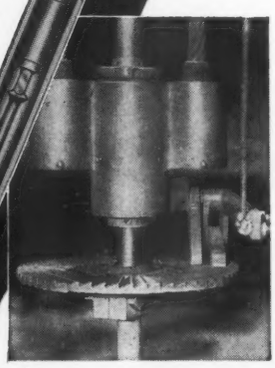

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This rod hanger rotates the rod string a fraction of a turn on each reciprocation. The horizontal teeth on the turn table are engaged by two ratchet levers which are actuated by a flexible steel cable attached to the walking beam. On each reciprocation the levers move the rod string a fraction of a turn.

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HUBER PARAFFIN SCRAPERS

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Freeport Sulphur Creates New Oil and Gas Division

Freeport Sulphur Company has formed a new division of the company to carry on a program of exploration and development in the oil and gas field.

The oil and gas division will have its headquarters in the American Bank Building in New Orleans, Louisiana, the location of Freeport's operating headquarters, and will open an office in the Gulf Building in Houston, Texas.

H. C. Petersen, who has been superintendent of land and exploration for the company for the past six years, has been appointed manager of the division. A graduate of the Minnesota School of Mines, Petersen joined the Freeport organization in 1934.

Wayne Bowman, consulting petroleum geologist, will be in charge of the Houston office. A graduate of the University of Texas, Bowman has been associated with the oil industry since 1920. He has been engaged in private consulting geological work in Houston since 1937.

Saudi Arabia Crude Oil Production Up in October

Crude oil production in Saudi Arabia averaged 486,865 bbl daily in October, an increase of 73,172 from September, according to a report by the Arabian American Oil Company. The company stated that October's production exceeded average figures for the first 10 months of the year of 480,395 bbl daily.

Total production in October was 15,092,814 bbl and in the 10-month period it was 146,040,061.

AIME Juniors Meet

The Pacific AIME Juniors held their regular meeting November 10 at the Rio Hondo Country Club in Downey, California. The symposium was held on "Chemical and Mechanical Treatment of Oil Wells to Improve Production."

The first speaker was E. G. Bemiss of Standard Oil Company who spoke on washing of low gravity wells having unconsolidated sands and interbedded, incompetent, shale bodies.

Other speakers were H. D. Aggers, Union Oil Company, and E. R. Smith, Seaboard Oil Company.

Cities Service Completes Well

Cities Service Oil Company (Delaware) has provided the second completion for the recent three-mile extension to the Kelley area of Scurry County, Texas. Its Von Roeder No. 1 was completed for a potential of 1124 bbl of oil daily through ¾-in. choke.

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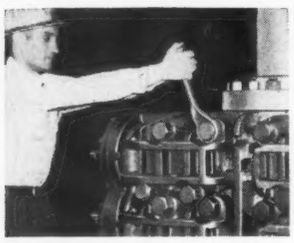
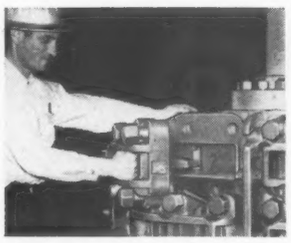
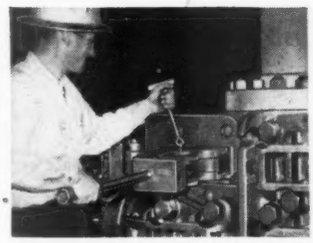


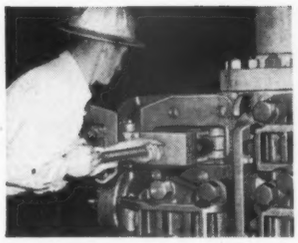
1. Unbolt Two Doors in the side of the Gate. You don't even have to remove the bolts—they remain in the doors where they can't become lost.



2. Swing the Doors Open and pull out the ram assembly. There's nothing to loosen, unlock or disengage. It slides right out.



3. Lift the Rams from the Gate and simply replace the Ram Blocks and rubbers with others of the desired size and type.



4. Slide the Ram Assembly back into the Gate, close and bolt the doors. Closing the doors automatically aligns Ram Assemblies within Gate.

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Best of all the unusual speed and simplicity with which rams can be changed is only one of *many* vitally important advantages that Shaffer engineers—pioneers in the development of high pressure control equipment—have incorporated into the Shaffer Hydraulic Cellar Control Gate. A few of the many other features are outlined at right. But be sure to get the *complete* story before you buy *any* cellar control gate equipment. No other equipment provides so much protection—in such a compact space—with so many operating advancements as . . .

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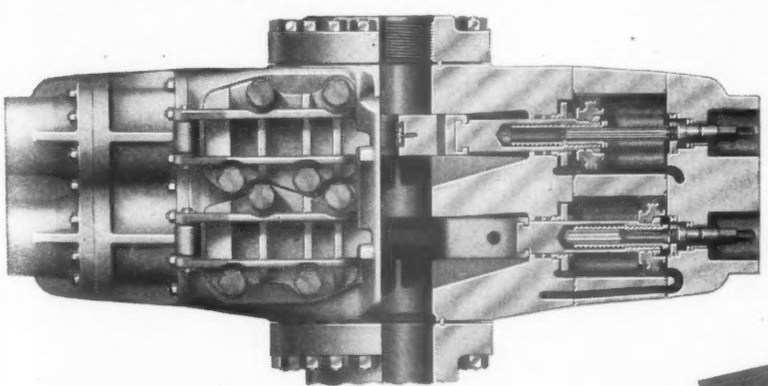

The sectional view above shows how *two* separate ram compartments are unitized into one compact body. Note the self-draining bottoms of the ram compartments . . . the direct hydraulic drive . . . and the completely enclosed design of the Shaffer Hydraulic Cellar Control Gate!

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See pages 4433 to 4496 of the 1950 Composite Catalog.

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WHAT'S DOING IN DRILLING

Mexican Company Finds First Offshore Field

Petroleos Mexicanos and the Mexican-American Independent Company have reported that the first offshore oil production for Mexico has been found in Southeast Mexico near Coatzacoalcos in the Isthmus of Tehuantepec region of Veracruz State.

Reports from the American-Mexican company indicate that this first well produced the equivalent of 1170 bbl daily on preliminary tests at a depth of 3782 ft. Officials state that they will drill further to test for other producing sands.

Although the producer was developed in the Gulf of Mexico waters, the well was a directional hole, started on the mainland and angled out into the Gulf. The new well is actually Mexico's first on the continental shelf.

Two Firms Get Their First Leduc Producer

Texaco Exploration Company and McColl Frontenac Oil Company have obtained their first production at Leduc in Canada. Situated in the D2 zone of the Devonian, the well is reported producing between 35 and 40 bbl an hour. The new Leduc well is on the southwest fringe of the area's production.

Reel for Catline Rope

Fast catline reel operation is the main purpose of the device shown in the accompanying photograph. Mounted behind the cathead, the reel can be spun to wind up the rope, and also pivoted in a circle to remove quickly any kinks that form in the line. The main reel is constructed of sucker rod welded to a 4-in. pipe hub. This is held in place behind the cathead by an upright pipe with threaded axle running through the main reel. The wheel mounted at the back of the main reel allows the whole unit to be turned to remove kinks as the line is wound on the reel. This turning unit is also made of sucker rod with a piece of sheet steel in the center to serve as an anchorage to the upright post mounted to the drawworks. The swivel feature is accomplished by a steel bar running from the smaller wheel to the hub connection of the larger reel. A peg locking device is inserted in the bar of the swivel wheel when unit is to be held stationary. This device is shown in photo in front of mounting post. An eye in front of the reel feeds the rope into position.

Shell Gets New Producer

From all indications, Shell Oil Company has a good oil producer in Beckham County, Oklahoma. Its No. 1 Walter "A" flowed at a rate of 24 bbl of 51 gravity oil an hour for two hours on a test with casing perforated between 9330-60 ft and packer set at 9316 ft. Flow was through ½-in. bottom and ⅝-in. top chokes.

Illinois has a total of 2189 oil and gas well completions for the first 10 months of 1949, an increase of 7.2 per cent for the corresponding 1948 period. Crude oil production declined 0.2 per cent, however, production from old fields amounted to 4,296,000 bbl, an increase of 13.1 per cent. New fields produced 48,769,000 bbl in the first 10 months, a decrease of 0.4 per cent from the year-earlier period. Producing wells amounted to 1179, an increase of 8.2 per cent. Average initial production of oil wells in the first 10 months was 91.5 bbl, compared with 107 in the year-earlier period.

Gas Field Opened in Wyoming

A new gas field has been opened by Husky Refining and Continental Oil Company at Salt Wells, in Sweetwater County, Wyoming. Their No. 1 unit is on a gauge of 8,000,000 cu ft daily. The Dakota zone was topped at 6260 ft and well drilled to 7214 ft, stopping in the Nugget. Casing was set at 6996 ft and perforated at 6262-86 ft.

Sunray Completes Scurry County Well

Sunray Oil has completed its R. B. Brown "B" No. 6 well, Scurry County, Texas, to produce on potential test at rate of 1208 bbl per day of sweet pipe line crude oil. The new Brown well marks the 9th Sunray completion in the Canyon Reef section of its Scurry County leases. The company is currently drilling two additional wells on its R. B. Brown leases.

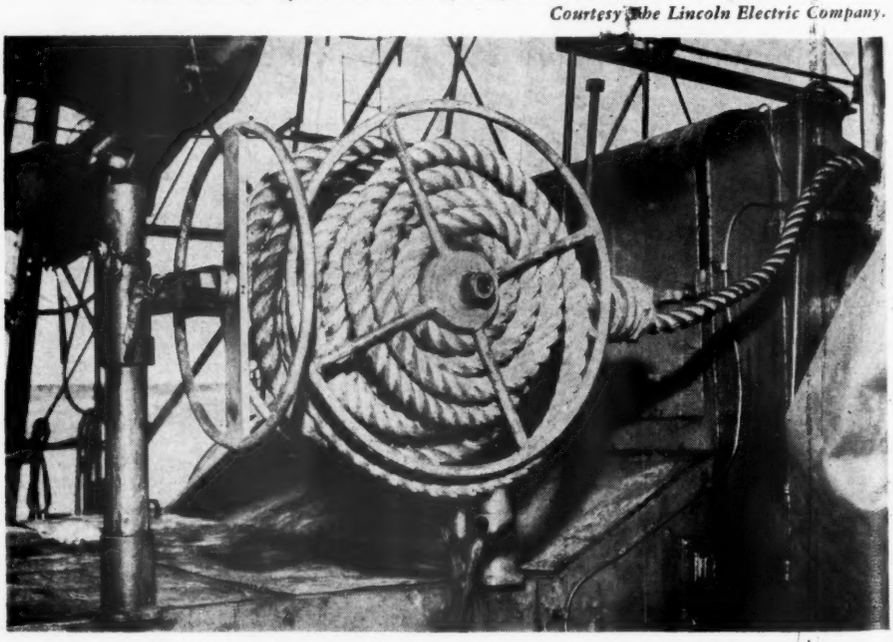
Sunray also announced completion of additional water input wells on its Fankhauser unit, Greenwood County, Kansas, and that total production on these leases which was only 34 bbl per day in February of this year has risen to more than 1000 bbl per day as the result of this water repressuring program.

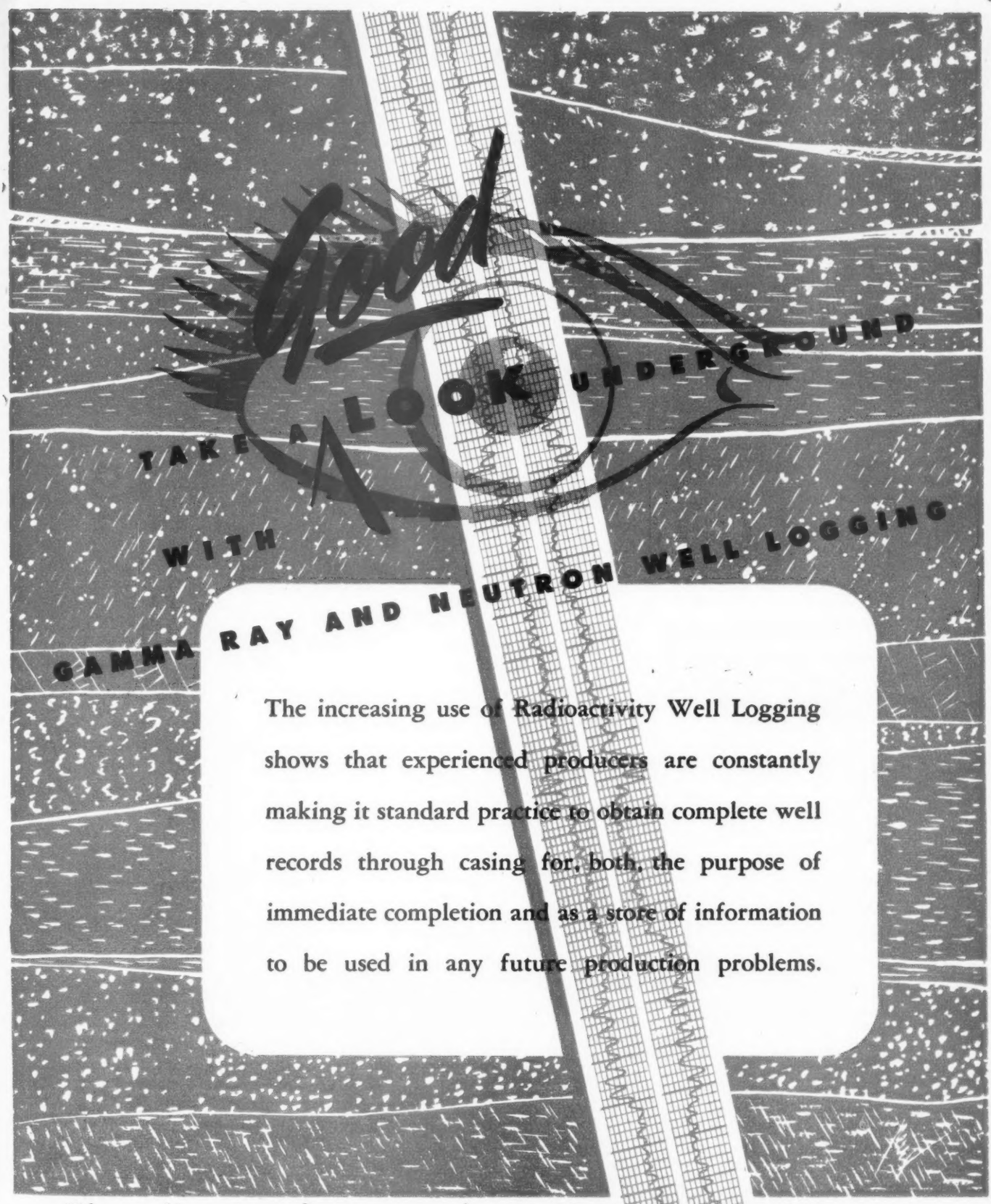
New Field Indicated In Louisiana Parish

A new field or a 4-mile eastward extension of the Waskom field in Caddo Parish, Louisiana has been indicated by the Plymouth Oil Company's No. 1 Thigpen-Herold. Using ⅜-in. bottom and quarter top chokes, and with tool open 20 min, top working pressure was 975 lb and a strong gas blow was recorded. Recovery included 20 ft of mud cut with condensate and 100 ft of gas-cut muddy drilling water with bottom hole flowing pressure of 1375 lb, shut in bottom hole pressure of 2725 lb and hydrostatic pressure of 3350 lb.

Reel can be spun to wind up rope without kinks in line.

Courtesy The Lincoln Electric Company.





The increasing use of Radioactivity Well Logging shows that experienced producers are constantly making it standard practice to obtain complete well records through casing for, both, the purpose of immediate completion and as a store of information to be used in any future production problems.

These licensees have run almost 20,000 Radioactivity Logs.

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Drilling and Exploration, Inc. Moves Headquarters

Drilling and Exploration Company, Inc. is moving its domestic and international headquarters to Abilene, Texas from Dallas, where most of its departments have their headquarters. J. E. Brantly, president, said new headquarters will include land, drilling, accounting, exploration, production, and foreign departments. Construction will start immediately on an office building in Abilene.

Humble Opens District Office

A district production office was organized in Winters, Texas, on December 1 to direct Humble Oil and Refining Company's drilling and production operations in that area. The new district will include operations in the Winters area now directed by Humble's West and North Texas divisions.

F. A. Jewell, formerly assistant district superintendent at Avoca, has been named superintendent of the new district. Six other men will be transferred to Winters with their families: W. C. Werner, now in the division office at Wichita Falls, will be the district chief clerk; R. A. Brand, now at Vernon, will be the assistant district chief clerk; W. E. King, district clerk, will be transferred from Pampa: F. G. Thomas, district petroleum engineer, will also move from Pampa where he has been in that capacity; William Thiebaud, tool pusher, will be transferred from the Hobbs, New Mexico district of the West Texas division; and D. K. Smith, farm boss, will be transferred from Means in the West Texas division.

Producing Areas Opened In the Illinois Basin

Five new oil producing areas have been opened in the Illinois Basin—three of them are in Illinois, one in Kentucky, and one in Indiana. The R. A. Harris No. 1 Akin in Lawrence County, Illinois, has a total depth of 1905 ft. It has been acidized and flowed 132 bbl of oil the first hour after perforating pipe and then flowed 1640 bbl in 24 hours. It is more than a mile from other oil wells, and opens a new area.

The Texas Company has completed its No. 1 E. E. Foster for 210 bbl a day from the McClosky limestone. The well is situated in Edwards County, Illinois. Total depth is 3330 ft. The Foster well is 1½ miles from another well, thus opening a new area.

In Henderson County, Kentucky the Kingwood Oil Company's No. 1 Dunn-Leach is on a production test of the Waltersberg sand at 1192 to 1195 ft. This well pumped 77 bbl of oil and 16 bbl of water in 11 hr and opens a new area two miles northwest of Newman, Kentucky.

The V-T Drilling Company's No. 1 Tom Helm is on production test of the Cypress sand at 1558 to 1565 ft, with total depth at 1886 ft. The well, situated in Warrick County, Indiana, is pumping 40 bbl of oil and 28 bbl of water a day.

In Hamilton County, Illinois, the Jim William Eberhart No. 1 Wesley Foundation is on a production test of the Aux Vases sand at 3200 to 3215 ft. It pumped and flowed 446 bbl of oil a day natural and is now flowing through the casing after a 30 qt shot of nitro.

Cities Service Completes Kansas Oil and Gas Wells

The completion of four gas wells for a total open flow of 66,000,000 cu ft daily, four Kansas oil wells for a total initial potential of 942 bbl of oil daily and the location of three Hugoton field gas wells was reported by Cities Service Oil Company (Del.).

In the Hugoton field of Kansas, McWilliams C No. 1 in Finney County was completed for an open flow of 20,100,000 cu ft of gas daily, McWilliams D No. 1 in Finney County for 18,000,000, Neill No. 1 in Haskell County for 17,800,000 and Tait B No. 1 in Finney for 10,100,000 cu ft.

Two Ray pool wells were completed. Included were Veeh No. 9 in Phillips County for 219 bbl and Veeh No. 10 in Norton County for 165 bbl. Durfee No. 4, a Bartholomews pool producer of Sedgwick County, was completed for a flowing potential of 468 bbl of oil daily. Rathbun No. 4 in the Edwards pool of Ellsworth County was completed for an initial of 90 bbl of oil daily.

Atlantic, Cities Service Complete Gaines County Well

Two producers for the West Seminole field of Gaines County, Texas, were reported completed by Cities Service Oil Company (Delaware) and Atlantic Refining Company. Situated at the northeast edge of the field, St. Clair No. 3 was completed in the San Andres lime at a total depth of 5170 ft for a potential of 680 bbl of oil daily. The potential test was through a 34/64-in. choke.

Whitaker A No. 4, at the northwest edge of the field, was completed for a potential of 192 bbl of oil daily through a 20/64-in. choke. Total depth and producing formation were the same as the St. Clair well. The West Seminole field is a Cities Service-Atlantic discovery.

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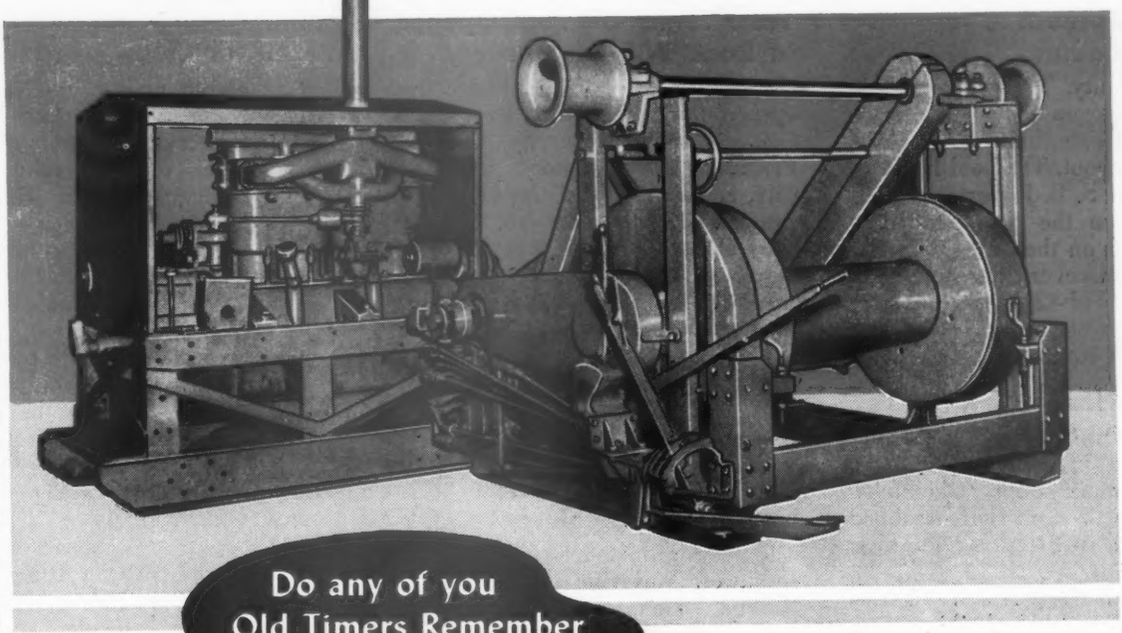

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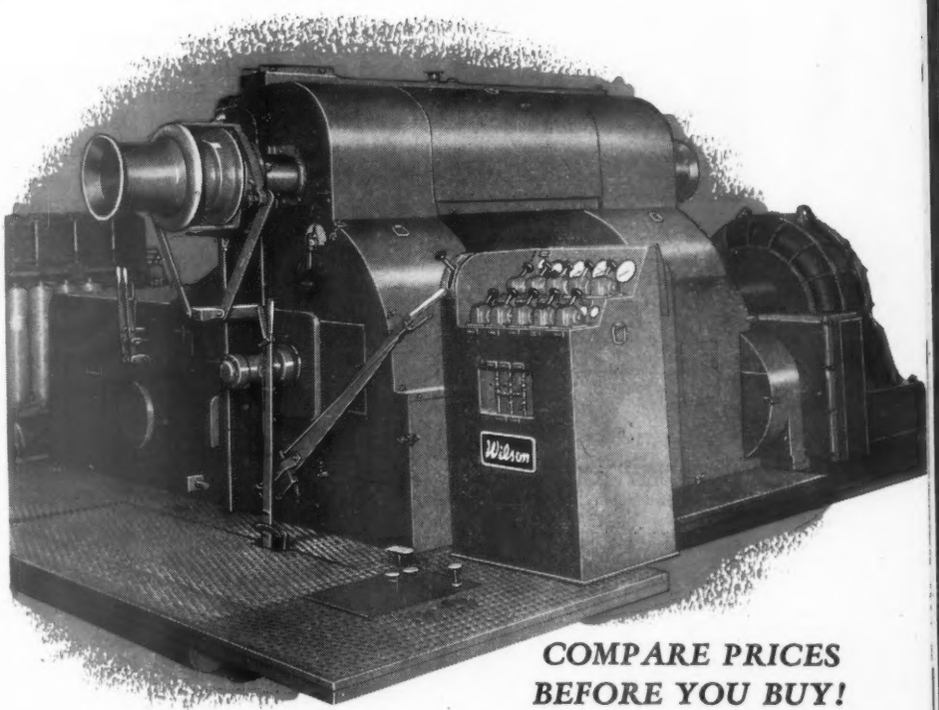

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EXPLORATION ACTIVITIES

Reef Pay Spreads In Scurry County

Scurry County, Texas, scene of the biggest oil play in the United States at the present time, has a new Canyon Reef lime oil pool. The pool has been opened by the S. B. Roberts et al No. Lewis, between the Kelly and Diamond M pools on the west side of the county. The discovery was completed to flow 611 bbl of 42 gravity oil daily, with pay from 6841 to 6863 ft, after acidizing with 4000 gal.

Midstates Has 2 New Wells

Midstates Oil Corporation has two oil producers in the Witcher pool area of Oklahoma County, Oklahoma. Its No. 1 G. W. Wright Heirs swabbed 110 bbl of oil in 24 hr, with a total depth of 6344 ft.

The second well, No. 1 Charles Wright, flowed 231 bbl of oil in 24 hrs through an 18/64-in. choke. Total depth is 6312 ft, perforated between 6270-98 ft.

West Texas Oil Pool Opened In Rank Wildcat Territory

An oil pool appears to have been opened in rank wildcat territory in Gaines County, Texas by Anderson-Prichard Oil Company, Oklahoma City, and Forest Oil Company of San Antonio, Texas. Their No. 1-A Parmer, situated 15 miles southeast of the town of Seminole, recovered water cushion and 563 ft of an oil-cut mud, and 4070 ft of clean, 41.1 gravity crude oil on a drill stem test of the lime between 12,045-156 ft. The companies may go as deep as 15,000 to test the Ellenberger.

New Formation Found In Maysville Pool

A new producing formation in the Southwest Maysville pool of Garvin County, Oklahoma, has been found productive by the California Company and The Texas Company. On drill stem test between 8505-30 ft, total depth, with tool opened 35 min, the water cushion was recovered in six minutes; gas, estimated at 5,000,000 cu ft a day, showed in eight minutes. It started flowing at a rate of between 10 and 20 bbl of oil an hour.

Louisiana Field Opened

A new oil field has been opened in Calcasieu Parish, South Louisiana, by the Niloco Company of Dallas, Texas. The No. 2 Industrial Lumber Company, 3½ miles southwest of De Quincy, flowed 239 bbl of 29.5 gravity oil daily through a $\frac{5}{32}$-in. choke from 6654 to 6664 ft depth. Tubing pressure was 1080 lb and gas-oil ratio was 439 to 1.

Makes Kansas Strike

Wilcox sand production has been opened just two miles north of the Oklahoma-Kansas state line at the Champlin Refining Company, Enid, Oklahoma, No. 1 Slentz, about five miles east of Caldwell, in Sumner County, Kansas. After drilling on the Wilcox at 5711-19 ft, total depth, the well flowed an estimated 20 bbl of oil and mud the first hour, then stepped up the rate of flow to 35 bbl of oil the third hour, flowing through casing.

Subsequent flows ranged from 25 to 48 bbl of oil an hour, with an average estimated flow of 35 bbl hourly through a 1-in. choke. There was an estimated 500,000 ft of gas a day.

Commercial Production Begun In Chile

Corporacion de Fomento has begun the first commercial production of oil in Chile after almost four years of development work. Producing area is in the northern part of Tierra del Fuego where the discovery was made in 1945. It is the world's southernmost oil field, situated near the Straits of Magellan. Producing rate is about 1000 bbl daily, and this is expected to increase as more wells are connected. Corfo, the Chilean Government organization, is in charge of the work.

Flows 265 Bbl in 23 Hr

Ray P. Diehl No. 1 Lee, Lincoln County, Oklahoma, flowed 265 bbl of oil in 23 hours from open hole in the Red Fork sand between 4160-85 ft. It then flowed 150 bbl in 11 hours through a one-half inch choke on tubing. The new producer is a north offset to the discovery well recently completed for 75 bbl of oil a day.

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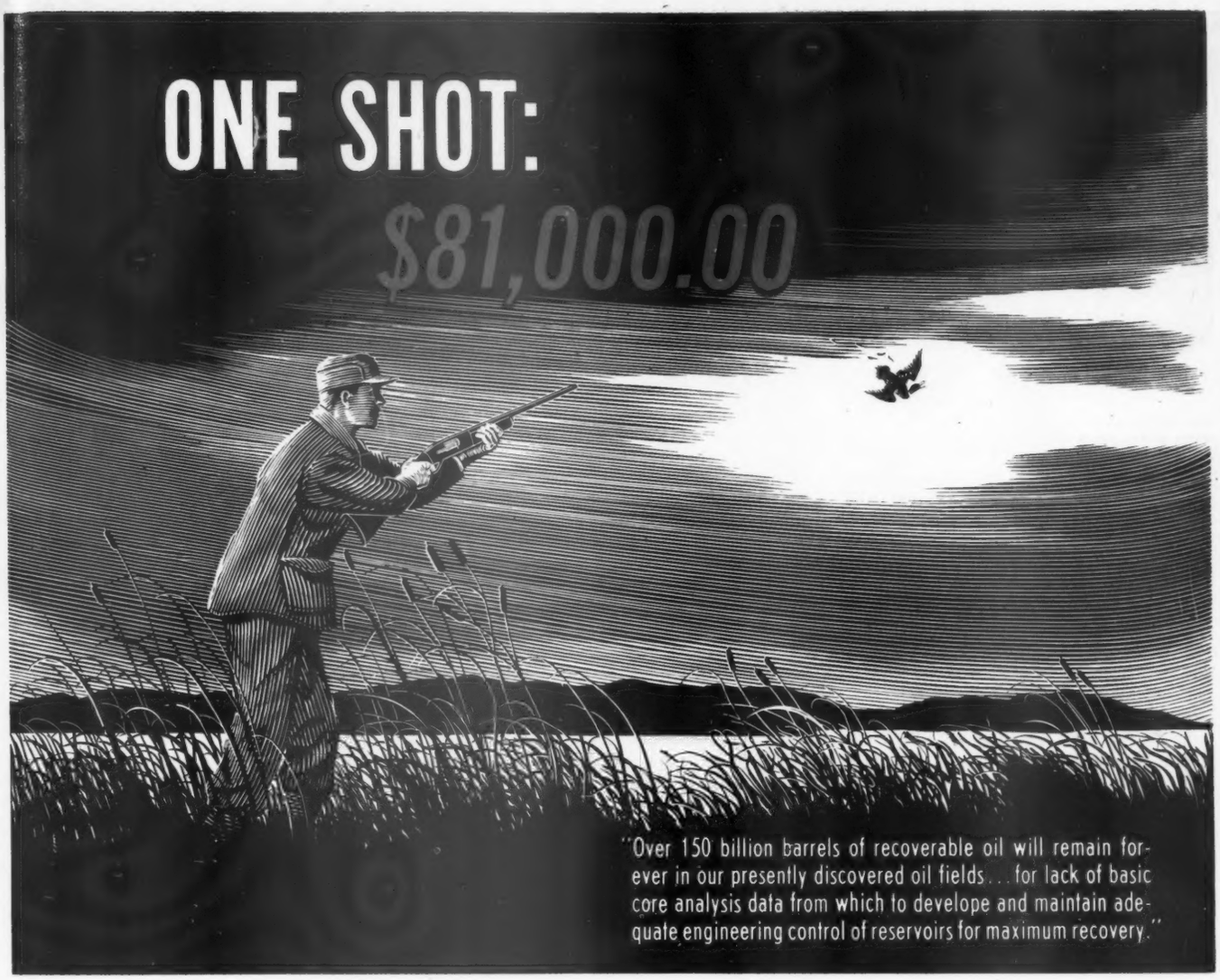
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Kansas Field Opened

A new oil field north of the North Hammer field in Barton County, Kansas is being opened by Aladdin Petroleum. It is the company's No. 1 Schartz, with pipe perforated at 3165-74 ft, and swabbed 60 bbl of oil in four hours.

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To Drill Nebraska Wildcat

Location has been staked in Cheyenne County, Nebraska for a new wildcat to be drilled by Ohio Oil Company. Ohio made a commercial oil discovery in this same county some months ago. The wildcat is to be situated three miles north of Sidney and six miles southwest of the company's Gurley field where discovery was made in the first Dakota sand early this summer.

Lion Gets Production In Cochran County, Texas

Development of flowing production on Lion Oil Company's Masten lease, comprising 2422 acres in Cochran County, Texas, was announced by T. M. Martin, president. The newly completed well, Masten No. 1, was tested and given a state potential of 202 bbl of 31 gravity crude oil daily.

The Masten No. 1 has encountered the same type production as that developed in the Levelland field, and it is presumed that the well is a southwest extension of that field by about three-quarters of a mile.

Imperial Drills in Japan

Imperial Oil Company's second well in the Yabase field, Akita Prefecture in Japan, has begun flowing without swabbing, making 90 bbl of oil and 35 bbl of mud in the first 24 hours. Pay is from approximately 4000 ft.

The company announced that seismic exploration has resulted in the discovery of a large anticline, parallel to and west of Yabase. Imperial is now planning to drill on the structure.

Drills Well in Arkansas

A new Smackover lime wildcat will be drilled by C. H. Murphy and Company, in the southern portion of the South El Dorado field of Union County, Arkansas. It is the No. 1 Pepper near the C. H. Murphy, Jr. No. 1 C. H. Murphy, abandoned as a dry hole in 1946 at 7870 ft.

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● Next, a series of heat-treating operations performed over the *entire length* of the Kelly in one operation, develop the metallurgical properties of the steel to provide the *best balance* of shock-resisting toughness and wear-resisting hardness.

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● All residual forging stresses are relieved by these heat-treating processes, thus eliminating the most prevalent cause of bending and deformation.

● The Kellys are then carefully bored by precision drilling machines so that the bore is precisely centered end-to-end, then double-checked by highly-accurate survey devices. For products with bores 2¼" diameter or larger, wall thickness of the Kelly *must not* vary more than one-*sixteenth* inch for each 10 ft. of product length, or fraction thereof.

● The Kelly itself is also accurately surveyed for straightness and *must* be straight within *one-eighth* inch when measured at *any* point over its entire length.

● The alignment of the projected axis of each threaded end, when checked with the precise Baash-Ross Alignoscope, *must* be within one-*eighth* inch of the longitudinal axis of the Kelly for each 10 ft. of Kelly length, or fraction thereof.

● In addition, threads *must* pass, not only all API specifications, but also unusually rigid Baash-Ross specifications on thread form, taper, lead, finish, etc.

The above highlight only a few of the many controls maintained by Baash-Ross to insure absolute straightness, long-life and maximum all-around performance from every Baash-Ross Kelly!

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2½	35 38 40	36–4 39–4 41–4	36–6 39–6 41–6	32 35 37	4½ Reg. 6⅝ Reg.	5½* 7¼	2¾ Reg 2⅞ I.F.	3¼ 4⅛	1¼ 1¼	3⅝2	2½	2⅜6	5/16	3⅜	*.165 .327
3	35 38 40	36–4 39–4 41–4	36–6 39–6 41–6	32 35 37	4½ Reg. 6⅝ Reg.	5½* 7¼	2¾ Reg 2⅞ I.F.	3¾ 4⅛	1½ 1⅝	3 15/16	3	2 15/16	3/8	4⅛	*.165 .327
3½	35 38 40	36–4 39–4 41–4	36–6 39–6 41–6	32 35 37	4½ Reg. 6⅝ Reg.	5½* 7¼	3½ Reg. 3⅝ F.H. 3½ I.F.	4⅛ 4⅝	1½ 2¼	4 1/32	3½	3 1/32	½	4¾	*.165 .327
4¼	35 38 40 54	36–4 39–4 41–4 55–4	36–6 39–6 41–6 55–6	32 35 37 51	4½ Reg. 6⅝ Reg.	5½* 7¼	4½ Reg. 4⅝ F.H. 4½ I.F.	5½* 5⅞ 6⅝	2¼ 2⅞ 2¾	5 9/16	4¼	4 1/32	½	5¾	*.165 .327
5¼	38 40 54	39–4 41–4 55–4	39–6 41–6 55–6	35 37 51	6⅝ Reg.	7¾	5½ Reg. 5⅝ F.H. 5½ I.F.	6¾ 7⅜	2¾ 3¼ 3¼	6 29/32	5¼	5⅝	⅝	7	.327
6	38 40 54	39–4 41–4 55–4	39–6 41–6 55–6	35 37 51	6⅝ Reg.	7¾	6⅝ Reg. 6⅞ F.H.	7¾ 8	3¼ 3½	7 7/8	6	6¾	¾	8	.327

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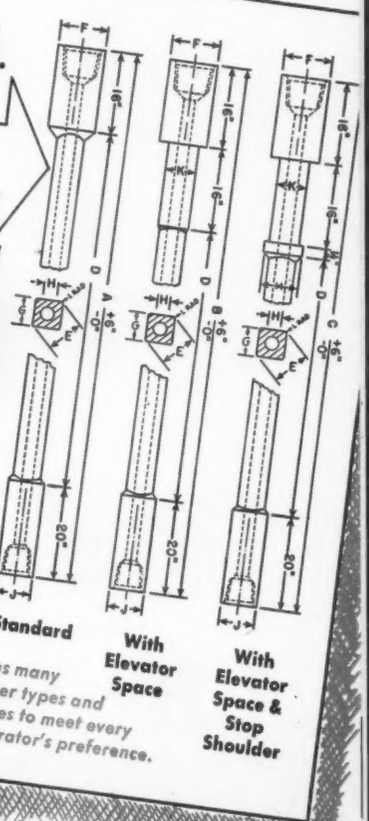

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****The Baash-Ross lines of Hexagon and Octagon Kellys are equally complete. Write for data.***

Osage County Gets Producer

A big producer has been added to the Big Bend field, in Osage County, Oklahoma by A. G. Oliphant, operator. His No. 6 Osage, in the extreme western sector of the county, topped the Layton sand at 2850 ft, set 7-in. casing at 2846 ft, and after drilling plug, flowed 700 bbl of oil in 24 hr.

Open New Pool in Louisiana

Union Producing Company and M. H. Pat Marr have completed at No. 1 Hudson, discovery well on the Big Island structure in Rapides Parish, central Louisiana. On tests, the well flowed 48.53 bbl of oil in three hours through a 14/64-in. choke, with gas oil ratio of 504-1. Pay is from the Wilcox sand.

Tests Louisiana Wildcat

Humble Oil and Refining Company is testing at a wildcat well in the Tiger Pass region near West Delta, Plaquemines Parish, South Louisiana. The Company's No. A-3 State, was drilled to 10,000 ft and 7-in. casing cemented at 9485 ft. Two miles north, Big Chief Drilling and Richard A. Campbell are drilling a 9000-ft wildcat.

Wildcat Completion Attempted

Dual-completion is being attempted at Continental Oil Company's No. 1 Royall National Bank, wildcat in the A. G. Monroe survey in Anderson County, east-central Texas. Total depth is 10,182 ft with casing set at 9822 ft. The well tested 76 bbl of 46-gravity oil and 136,000 cu ft of gas through a 3/8-in. choke in five hours. Through perforations in the lower Rodessa at 8965-90 ft, the well flowed 75 bbl of distillate and 422,342 ft of gas in four hours through a 1/4-in. choke.

Oklahoma Well Flows 300 Barrels in 24 Hours

Midland Co-op and T. T. Eason's No. 1 Gillaspy in Noble County, New Mexico, was drilled to a total depth of 4745 ft in the Mississippi lime, and acidized with 2500 gal. After recovering load, the well swabbed 300 bbl of oil in 24 hr, followed by subsequent swab gauge of 240 bbl during the next 24 hr. Their No. 2 Gillaspy is drilling below 3062 ft.

Deep Rock Stakes Location

Location for a new test has been staked by Deep Rock Oil Company in the West Norfolk pool in Payne County, Oklahoma. Deep Rock already has one producer in this area.

Its No. 2 Marcellus set 7-in. casing on top of the Peru sand, drilled out to total depth of 2807 ft, and swabbed and flowed 85 bbl of oil in about 14 hours through a $\frac{5}{16}$-in. choke.

Delhi Makes Discovery In Dakota Sand

Delhi Oil Corporation's No. 1 Ingwersen, Rio Arriba County, is the new Dakota sand oil discovery that may establish a 100-mile belt of oil production in northwestern New Mexico. The new well in the San Juan basin, is 100 miles east of the Rattlesnake well opened in 1942. It is bottomed at 7750 ft, and recovered 1530 ft of heavy oil and gas-cut, 2130 ft of clean 45 gravity oil, and 630 ft of mud-cut fresh water on a drill stem test. It is now running 7½-in. casing.

Alberta Oil Pool Extended

British Empire Oil Developments Ltd.'s Settler No. 1 well, new oil discovery, will extend the Stettler Devonian oil pool three miles northward. The new well recovered a 3870-ft column of clean oil in a one-hour drill stem test of the D2 zone of the Devonian. The D2 test was run from 5201 to 5215 ft, and in addition to the oil recovery, got a flow of natural gas rating 50,000 cu ft a day to the surface in five minutes.

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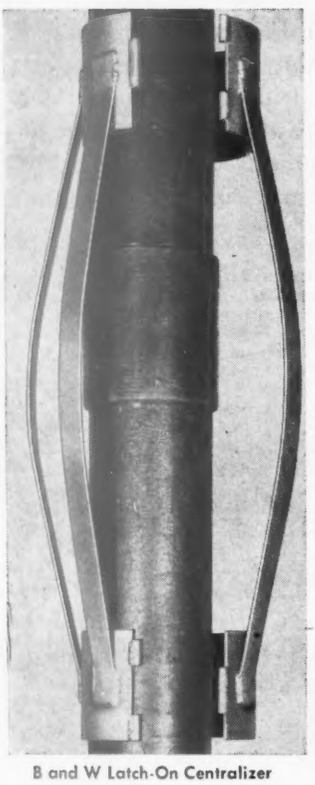
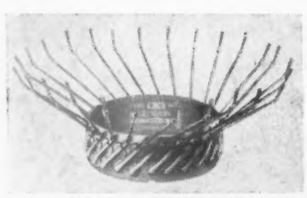


B and W Latch-On Centralizer



B and W Multi-Flex Scratcher

IT'S EASY TO KNOW ahead of time that you're going to get a better cement job . . . that you'll avoid need for squeeze cementing . . . that you'll have a more profitable well completion—*and at just a fraction of the cost of having a cementing failure on your hands!*

First—*Centralize the casing* with simple, easy-to-install B and W Latch-On Centralizers. Effective casing centering eliminates channeling in the cementing zone and insures the best possible cementing bond between casing and hole wall. Latch-On Centralizers are of split hinge construction to permit quick, money-saving installation on either collared or external upset casing, and are made in straight and spiral types for all well conditions.

Second—*Remove mud cake* with B and W Multi-Flex Scratchers installed on the casing through the desired cementing area. Strong multiple-wire fingers 5" long combine strength with reversibility . . . are flexible to adapt themselves to hole contour for minimum disturbance of the mud cake while running in . . . insure *complete mud removal* during cementing.

We'll gladly supply full information on how you can use this B and W equipment for better well completions. Write today.

Don't Squeeze! . . . it CAN be avoided

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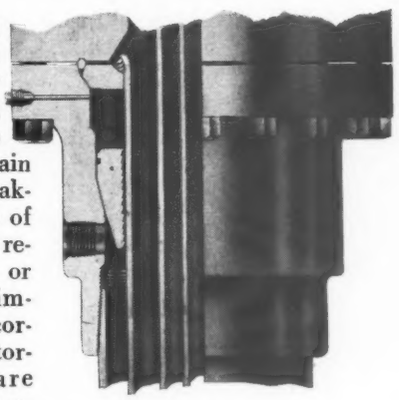
MAKING THE OIL INDUSTRY *Safer*

The extent to which Rector Tubing and Casing Heads Fulbore Cementing and Rectorseal have accomplished this purpose is proved by their years of dependable service to the oil industry throughout the world. This equipment delivers a measure of economy and efficiency unmatched by any other.

The safety of steel seals in
CASING & TUBING HEADS

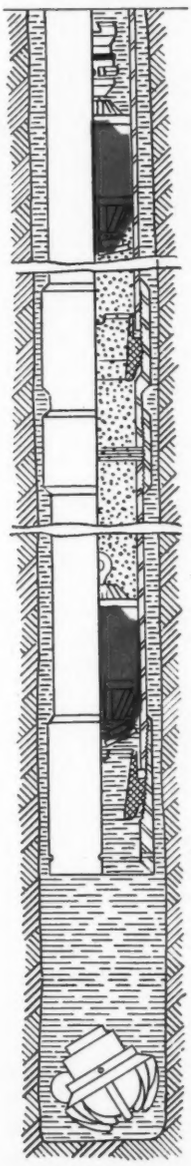


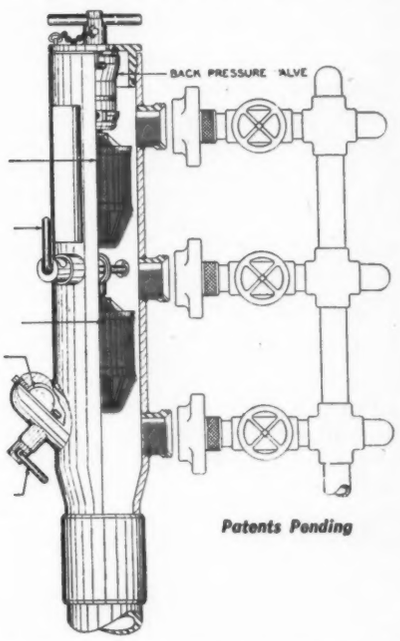
Rectorhead casing and tubing heads have no resilient packing. They utilize an all steel seal of a good weld plus API ring gasket to obtain a positive permanent leak-proof seal for the life of the well. These seals require no maintenance or replacements; are immune to the effects of corrosion inhibitors. Rectorhead casing heads are available in mandrel or slip suspension types. Two types of tubing hangers are available which meet all tubing suspension requirements. They are interchangeable in all type M bodies.

The safety of leak-proof connections with
RECTORSEAL

Rectorseal has been proved by its use in the oil fields for the past twelve years, where it has been used on casing and tubing joint connections, in high pressure oil and gas wells withholding pressures up to 8350 lbs. per square inch. As the result of its ability to prevent connection leaks under this pressure, RECTORSEAL has become the standard thread and gasket sealant for the oil producing industry. Insoluble in all petroleum fractions and water.

The safety of a master cementing job
FULBORE CEMENTING





Patents Pending

Delivering uncontaminated cement to the bottom of the hole assures maximum effectiveness of the cement in the annulus behind the casing. This is accomplished by segregating cement between two piston-like plugs during its entire travel down the casing. The three-inlet cement head permits pumping in maximum volume cement as rapidly as desired; prevention of air from entering the fluid column assures positive shut-in control throughout cementing operation. Entire float assembly is ejected from the "Fullbore Float Shoe" to permit full casing bore discharge of cement into the casing annulus.

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MAKING THE OIL INDUSTRY SAFER!

ASSOCIATION OF WELL HEAD EQUIPMENT MANUFACTURERS

running tour with men in the industry

▸ **Roger H. Sherman,** who for the past 20 years has been engaged in oil exploration work for Standard Oil Company (New Jersey) and affiliates, has been appointed coordinator of all producing activities, effective November 1, the company announced.

Sherman succeeds **John W. Brice,** who recently was elected to the board of directors of Standard Oil Company (New Jersey). At the same time it was announced that **M. A. Wright,** who has headed the Eastern Hemisphere division of the producing coordination department, will succeed Sherman as deputy coordinator. He is a graduate of the University of Colorado with a BA degree in geology.

Wright was born in Blair, Oklahoma, April 9, 1911, and was graduated from Oklahoma A. & M. College in 1933 with a BS in civil engineering. His first job in the oil business was as a junior engineer for The Carter Oil Company, a Jersey Standard affiliate, in the Seminole field in Oklahoma in 1933.

▸ **W. O. (Bill) Whiteside,** 48, of Longview, one of Texas' best known oil production superintendents, died of a heart attack at Paris, Texas. A veteran employee of Byrd-Frost, Inc., which he joined in 1932 as a roustabout, Whiteside had an extremely wide acquaintanceship throughout the oil industry.

After serving as superintendent of production for East Texas for Byrd-Frost, in 1940 he was made general superintendent over all East Texas properties and the Talco properties at Mount Pleasant.

▸ **W. W. Cline** of the San Joaquin Drilling Company, Los Angeles, who was made a regional director for American Association of Oilwell Drilling Contractors at the ninth annual meeting of the association in Dallas, was elected chairman of the California Chapter of the Association for 1950 at the regular October meeting. He succeeds **E. J. Simonis,** Santa Maria Drilling Company.

A. H. Bell, Bell and Burden, Inc., was elected vice-chairman for the Southern California area, and **Harvey Davis,** Crown Drilling Company, Bakersfield, was elected vice-chairman for San Joaquin Valley.

Lee Daniels, Loffland Brothers Company, Los Angeles, was re-elected secretary of the chapter.

Glenn M. Stearns

▸ **Glenn M. Stearns** has been appointed chief engineer of the Mid-Continent division of The British-American Oil Producing Company. In this capacity he will supervise the engineering personnel and be responsible for all engineering phases of the drilling and production operations.

Stearns is a graduate of the University of Oklahoma (1936) with a BS degree in petroleum engineering, having obtained an AB degree in chemistry at the Oklahoma Baptist University. In 1938 he became assistant professor of petroleum engineering at the University of Oklahoma and in 1947 he joined the Stanolind Oil and Gas Company as assistant to the chief production engineer. He was later promoted to development superintendent in which capacity he has served until his present appointment with the British-American. Stearns is a member of the AIME, API, Tau Beta Pi, Sigma Gamma Epsilon, and is a registered professional engineer in the state of Oklahoma.

▸ **A. Hennebeck,** field superintendent for Argo Oil Company, has been transferred to a similar position in the Lance Creek Field. Hennebeck has been field superintendent at Hamilton Dome, Wyoming, for the past 22 years. W. A. Peterson, is moving from Hamilton Dome to replace Hennebeck at Lance Creek.

▸ **George L. Nelson** has been promoted from production foreman in Magnolia Oil Company's Brownfield district in West Texas to assistant district superintendent of the Brownfield district.

Herman A. Hanks, production foreman in Magnolia's Panhandle district, has been transferred from Pampa, Texas, to the Brownfield district.

▸ **Edward L. Stauffacher** has been named assistant to **William H. Merritt** of Chicago, vice president of Cities Service Oil Company (Delaware) and manager of its marketing division.

Stauffacher was promoted from the position of chief engineer and superintendent of operations in charge of the company's marketing properties. He graduated from the University of Minnesota in 1925 with a degree in mechanical engineering.

▸ **George Samuel Bays,** consulting engineer for Stanolind Oil and Gas Company, died Wednesday evening, October 19, at his home in Tulsa, Oklahoma. Death was attributed to a heart attack.

Well known throughout the oil industry, Bays had devoted nearly all his working career to the petroleum business. He was one of the first in the industry to advocate conservation practices in the production of oil and gas, and was a staunch supporter of strict conservation policies. He had been identified with Stanolind since 1931.

▸ **Hallan N. Marsh,** General Petroleum Corporation production engineer, has been cited by the American Petroleum Institute "for distinguished service" at the Institute's annual meeting now in session in Chicago. A certificate of appreciation was presented to Marsh by the Institute's division of production. He was one of seven men in the nation so honored.

Marsh's citation detailed his 21 years of service to the Institute's standardization program for oil field equipment. He is currently national chairman of the Committee on Standardization of Pumping Equipment and Engines.

▸ **Roger J. Wolfe,** Grey Wolf Drilling Company, who was elected vice president for Gulf Coast of American Association of Oilwell Drilling Contractors at the ninth annual meeting in Dallas, was elected chairman of the Houston chapter of the association at a meeting held in Houston, November 1. He succeeds **W. Gilbert Prince,** Prince Drilling Company, Inc.

J. F. "Pat" Corley, Production Service Company, was elected vice chairman, succeeding **Rex Parks,** Loffland Brothers Company.

Liquid-blast ROCK BIT

it cleans the bottom of the hole

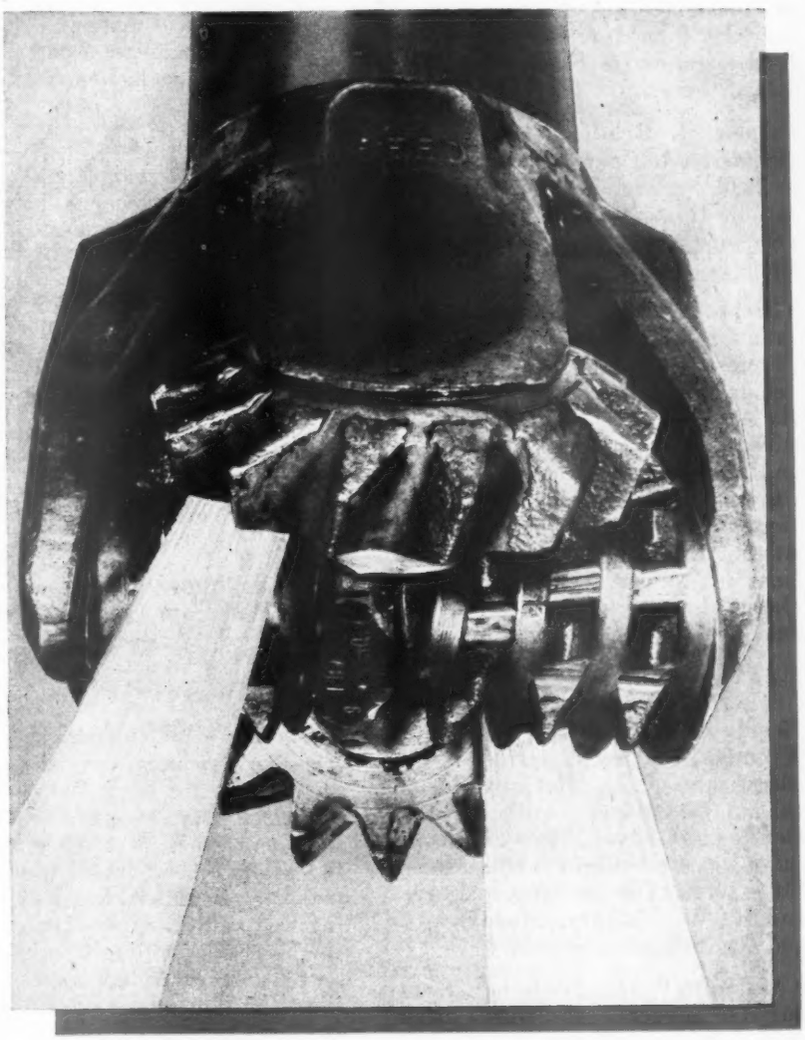
For better cutter tooth cleaning action and more effective utilization of the drilling fluid energy... for faster penetration and more hole per bit

The new Reed Liquid-Blast ("LB") Rock Bits were designed to more effectively utilize the output of the surface pumping equipment.

The bit body has been designed to permit the use of a slush nozzle giving a more effective distribution of the drilling fluid and with nozzle openings designed to direct powerful jets between the cutter teeth and onto the bottom of the hole.

This powerful jetting action, however, is not entirely dissipated on the cutter teeth but continues on to the bottom to remove the bit cuttings rapidly from the bottom of the hole.

Reed "LB" Rock Bits, therefore, are continually cutting on new formation, and the possibility of re-cutting formations already loosened is practically eliminated.



Don't let your rock bit rotate in a "pan of gravel" but specify the bit that cleans the bottom of the hole—the new Reed "LB" Rock Bit.

Reed **ROLLER BIT COMPANY**

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THE MARK OF QUALITY

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▸ **J. M. Pattinson** has been appointed deputy director of Anglo-Iranian Oil Company's production department, with headquarters at the main office in London. He has been in charge of the fields and geological division for Anglo-Iranian since 1945.

A graduate of Cambridge University and the Royal Military Academy, Woolwich, Pattinson served during World War I in the Royal Field Artillery. Upon graduation from Cambridge, he went to Persia, and in 1937 became general manager for Anglo-Iranian in Iran.

▸ **James D. Clark** is now reservoir engineer in the production department at Houston, Texas, for Stanolind Oil and Gas Company. He was formerly field engineer for Stanolind in High Island, Texas.

▸ **Jack H. Bradford** was recently transferred to Heidelberg, Mississippi, as field engineer for Gulf Oil Corporation. He was formerly field engineer for Gulf at New Hebron, Mississippi.

▸ **Heston Cathey,** Gulf Oil Corporation, Hobbs, New Mexico, was elected president of the New Mexico Oil Scouts Association. Other officers are: **R. A. Whitson,** Mid-Continent Petroleum Corporation, Midland, Texas, and **W. G. Smith,** Standard Oil Company of Texas, Artesia, New Mexico, vice presidents; **R. M. Knoepfel,** Atlantic Refining Company, Carlsbad, New Mexico, yearbook editor; **Roger Harrold,** Ohio Oil Company, Seminole, Texas, secretary-treasurer.

▸ At a recent meeting of the Wyoming Geological Association, **George Berry,** Sun Oil Company, Casper, Wyoming, was elected president. Other officers are: **J. H. McCoy.** Sinclair Oil and Gas Company, and **Klass Van Der Weg,** General Petroleum Corporation, vice presidents; **Allan Cree,** Cities Service Oil Company, treasurer; and **R. W. Mallory,** Stanolind Oil and Gas Company, secretary.

▸ **Malcolm F. Hardy** has been transferred to Snyder, Texas, from Chickasha, Oklahoma. He is a driller for Keating Drilling Company.

▸ **A. V. Hargis** recently joined Independent Exploration Oil Company, Houston, Texas, in charge of an exploration crew making geophysical surveys near Edmonton, Alta. Hargis was formerly with Stanolind Oil and Gas Company.

▸ **Robert L. Shick,** district engineer for Sohio Petroleum Company is now serving as district engineer at Evansville, Indiana, where he was transferred from Mount Vernon, Illinois.

▸ **Chester A. Baird** has been named assistant manager of Eastern Hemisphere operations in the foreign production division of Gulf Oil Corporation in New York. He is a former executive assistant in the Mene Grande Oil Company in Venezuela.

E. E. Ferrin has been named executive assistant in charge of technical matters for Eastern Hemisphere operations. Ferrin has been chief engineer in Kuwait.

H. J. Wharton, formerly executive assistant in the New York office, has been appointed assistant manager of Western Hemisphere operations. **R. E. Westling** was named executive assistant in charge of Western Hemisphere technical matters.

These changes are a part of the recent foreign production division reorganization.

▸ **Edwin Van Der Bark** has been named district geologist in West Texas for Phillips Petroleum Company. He was formerly assistant geologist for Phillips in that area.

▸ **Hollis D. Hedbert** was recently appointed head of the exploration department, foreign production division, Gulf Oil Corporation with headquarters in New York City. He will be in charge of geological and geophysical work in connection with exploration and development activities in foreign areas. Hedberg has been an employee of Gulf for 21 years.

▸ **Asa D. McRae,** geologist for Magnolia Petroleum Company, has been transferred to Lake Charles, Louisiana. He has been geologist for Magnolia in Morgan City, Louisiana.

▸ **George W. Graham,** T. G. & M. Drilling Company has been elected chairman of the North Texas chapter, American Association of Oilwell Drilling Contractors, at a recent meeting in Wichita Falls, Texas. Former chairman is **E. B. Clark,** E. B. Clark Drilling Company. **Frank Harvey,** Harvey Brothers Drilling Company, was named vice chairman, succeeding **R. Clay Underwood,** of Underwood Drilling Company; **Phil Bolin,** D. H. Bolin and Sons, was elected secretary succeeding **Dee Ford,** of Moran Brothers, Inc.

▸ **Will I. Lewis, Sr.,** Mt. Vernon, Illinois, was elected chairman of the Tri-States Chapter of American Association of Oilwell Drilling Contractors for 1950, at the October meeting held in Fairfield, Illinois. He succeeds **Ira Van Tuyl,** V-T Drilling Company, Evansville, Indiana, who was elected vice president for Illinois, Michigan, Indiana, and Kentucky at the ninth annual meeting of AAODC in Dallas.

▸ **O. B. Chamrad,** Houston Natural Gas Corporation, has been moved to Corpus Christi from Alice, Texas, as district production engineer. **L. M. Stevens,** has joined the Corpus Christi office as dispatching engineer. **Paul B. Rogers** is to be transferred from the distribution department at Alice to the production department as Alice field man.

▸ **Carl M. Krog,** production engineer, Pan American Production Company, Dickinson, Texas, was recently transferred to the company's Houston offices as production engineer. **Mack C. Murray,** has been moved to Abilene, Texas, where he will supervise drilling and production activities. He has been production engineer at Houston, Texas.

▸ **Warren M. Henker,** Imperial Oil Company, Ltd., was transferred to Devon, Alta, Canada, as production geologist. He is a former exploration geologist at Bogota, Colombia, South America.

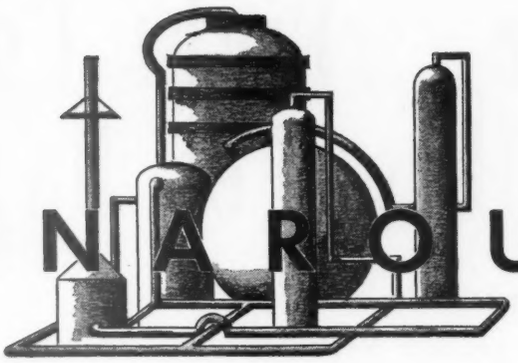
▸ **F. L. Cuilty** recently joined the staff of Independent Exploration Company, Houston, Texas, as foreign relations representative for Latin America. His office will be in Mexico City. Cuilty's long association with the petroleum industry includes work with the Guaranty Trust Company of New York and with Doheny interests in Mexico, where he was assigned to the Huasteca Petroleum Company and the Mexican Petroleum Company of California. Later he joined Standard Oil Company (New Jersey), serving in New York and London, and specializing in Latin American business.

Cuilty was commissioned as Lieutenant Commander in the U. S. Navy during the war and terminated his active duty on Fleet Admiral C. W. Nimitz' staff. After his release from the Navy, he returned to Mexico where he engaged in private business, until joining Independent Exploration Company.

▸ **H. G. Botset,** head of the petroleum engineering department in University of Pittsburgh's School of Mines, has accepted appointment as technical advisor to the production research committee of the Pennsylvania Grade Crude Oil Association. Botset will continue in his post at the University of Pittsburgh and will assist the Association on a consulting basis.

▸ **E. D. Grimes** has joined Cherokee Drilling Company as tool pusher, and will be stationed at Ballinger, Texas. He is a former driller for Ray and Harris at Robert Lee, Texas.

THE TURNAROUND



The (5W) Oil's the Thing!

PRECONCEIVED notions are hard to unseat, but the oil refining and automotive industries have achieved a signal victory in showing the advantages derived from the use of ultra-light crankcase oils in northerly climes of very low winter temperatures. Opposed strongly by active operators and marketers in both industries the proponents of this 5W lubricating oil continued their efforts with the result that their claims and beliefs appear to have been vindicated completely by extensive field experience by average automotive equipment operators.

SAE grade 10W oil has been the lowest viscosity lubricant recommended for crankcases for many years. Satisfactory for winter starting in most areas of the U. S. and Canada, it still makes operations difficult in the Rocky Mountain regions, in the Prairie Provinces of Canada and elsewhere, where winter lows reach minus 60 and lower. The 5W experimental grade was established based on a highly refined Mid-Continent or similar stock of 95 viscosity index, to which a VI improver was added to raise its rating to 130 VI and higher. So fortified its 300 F viscosity is about 34, very slightly lower than that of 10W oils of comparable derivation. Tested for 75,000 miles in various vehicles at temperatures of minus 40 F, it showed promising results; mileage of more than 800 miles per Imperial quart, no higher or only slightly higher than 10W; a much better record for cold starting than the heavier oil.

In the winter of 1948-9 the oil was placed on the market; its sales represented 13 per cent of total oil sales where it was offered. Strong opponents became "overnight" enthusiastic boosters for its use. It eliminated or minimized the need for "booster' starting batteries on farms, etc., or kerosine in the crankcase, and other crutch-aids. Its zero F viscosity was held at 1800-3200 Saybolt seconds, and the pour point, undoped, was minus 5 F, reduced to minus 40 F by additives.

As with any specialty it is necessary to understand the limitations and the purposes of the new proposed SAE grade oil, and to be guided by these limitations for its use. It is not to supersede 10W oil, technologists point out, except in those cases where winter temperatures of minus 20 F or lower are likely to prevail; the designation 5W is not a quality specification but merely a viscosity classification, the same as other grades in the SAE classification. Consequently, since this proposed grade is defined only by its viscosity at zero F, it is possible to manufacture oils to meet that viscosity which, due to low VI or other shortcomings, may be totally unsuitable for the expressed purpose. Nor can this proposed grade guarantee quick starting at low temperatures; it cannot correct faulty ignition, poor carburetion or any other of the multitudinous ills to which automotive engines are heir. Yet it is a great step forward in winter lubrication—ALF.

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Houdriflow units ordered set record for all Catalytic Cracking Processes

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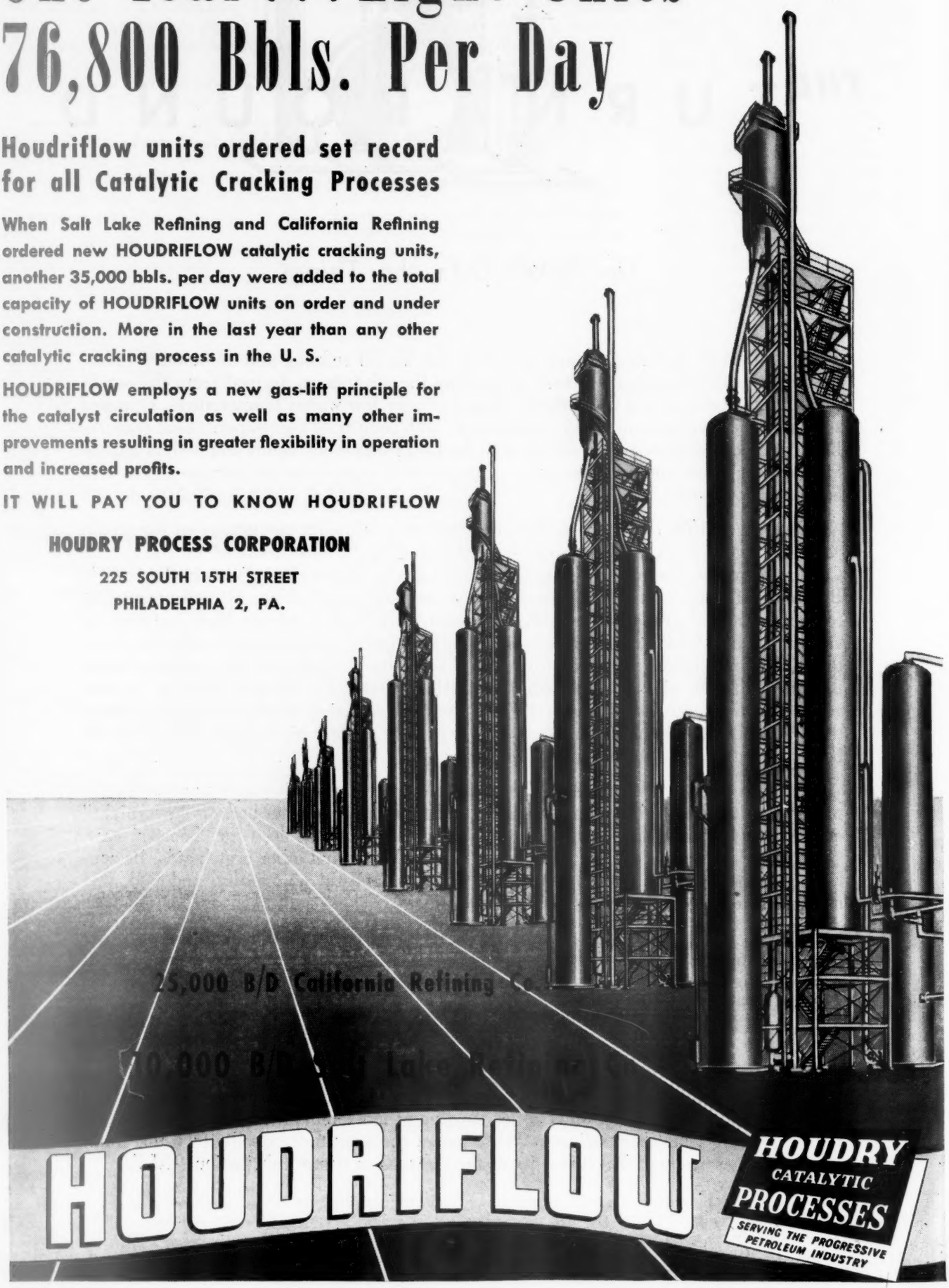
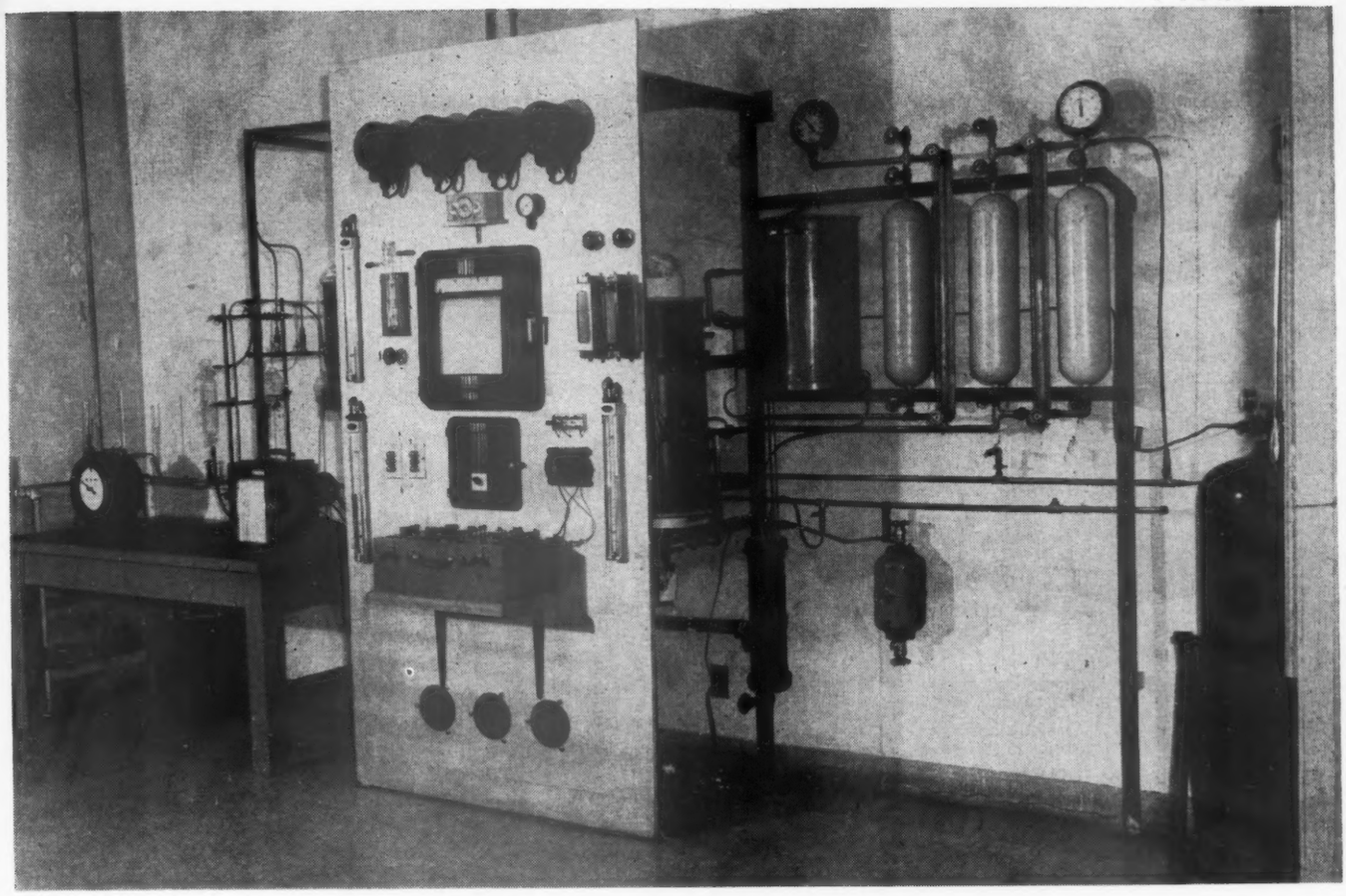




Experimental instrumentation layout including a LEN temperature recorder controller.

SOME FUNDAMENTALS OF TEMPERATURE MEASUREMENTS WITH THERMOCOUPLES

G. L. FARRAR and A. M. PLATT*

THE measurement and control of temperature is one of the most important operations carried out in industrial processes. Temperature is often the most important single process condition affecting quality, yields, amount of conversion per pass, types and amounts of various products, amount of separation, required sizes of equipment, or many other important process considerations. All processes in commercial production require the measurement or measurement and control of temperature at a number of points in the process. Consequently, the selection of a dependable, inexpensive, readily adaptable element for measuring temperature is an important factor in proper operation of the process. By varying materials of construction and methods of installation the thermocouple may be used for high or low temperatures, high or low pressures, oxidizing or reducing atmospheres, or under a variety of other conditions. For these reasons the thermocouple has wide application as a temperature measuring element. It is the purpose of this article to present some of the fundamentals of composition, construction, and operation of the thermocouple and its proper installation in the process.

*G. L. Farrar and A. M. Platt are assistant professors, Department of Chemical Engineering, Agricultural and Mechanical College of Texas.

EXCLUSIVE

The principle of operation of the thermocouple is that when two wires of different composition are fused together at one end and the fused end heated, an electromotive force (emf or potential difference) is generated. The reasons for this phenomenon are quite complex and not completely understood. Detailed discussion of this theory is beyond the scope of this article. The magnitude of the generated emf is dependent on the compositions of the two wires and the tem-

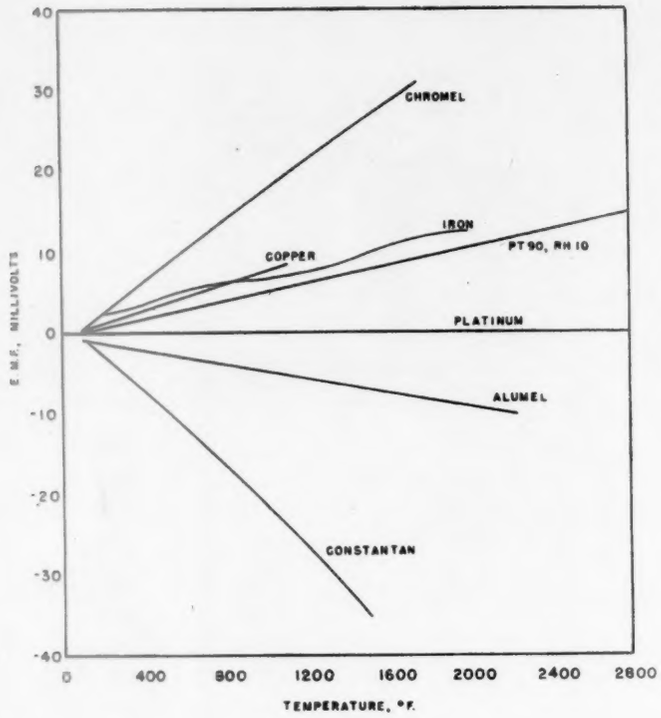


FIG. 1. Emf characteristics of various metals compared to platinum and usable in thermocouples.

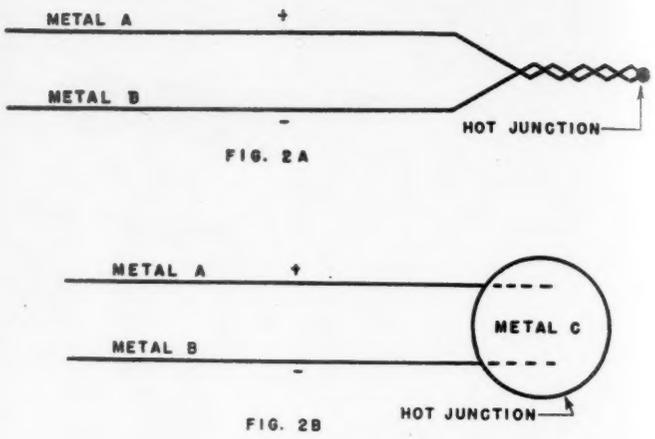


FIG. 2. Thermocouple construction.

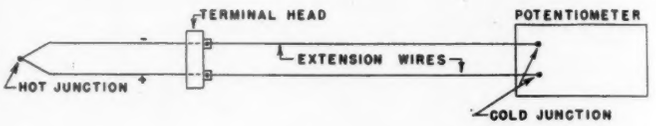


Fig. 3. Basic thermocouple circuit.

perature difference between the hot fused end (or hot junction) and the cold ends of the wires (cold junction). The emf generated is the sum of two different components, the Peltier emf and the Thomson emf. The Peltier emf is the portion of the total emf of a thermocouple that is produced by the junction of two dissimilar wires. Although this potential difference varies with the temperature difference between the junction, the variation may not be uniform. The Thomson emf is the portion of the total potential caused by the difference in potential that exists in a single section of homogeneous wire having a temperature gradient.

It is possible to use any two dissimilar metals in making a thermocouple, however, for reasons of accuracy and consistency the metals should be chosen such that (1) the Thomson emfs in each wire and the Peltier emf are mutually additive, (2) both emfs vary directly with temperature, and (3) the potential generated by the couple should be as great as possible. It is not possible to obtain all these characteristics in any one thermocouple, but some combinations of metals conform reasonably well. In addition to these factors, the thermocouple should be resistant to corrosion under the conditions of application and should have continued reproducibility within narrow limits.

The most accurate type of thermocouple in current use and one which most nearly meets the requirements set down above is the so-called "noble metal" thermocouple. Possibly the most widely used couple of this type is made of a positive wire of 90 per cent platinum and 10 per cent rhodium and a negative wire of pure platinum. This is a standard for temperature measurements requiring the highest accuracy and precision. The greatest disadvantage of this couple is its high cost. Another drawback is that the potential generated per degree of temperature difference between its junctions is small, and accurate instruments are necessary for measuring the potential generated. Most industrial applications do not require the accuracy afforded by this couple, however, it may be used as a standard for calibration of the thermocouples selected for use.

The "base metal" couples are used commonly for industrial applications. It is common practice to use one of three or four kinds of these thermocouples, the choice depending on the temperature range. Within the proper ranges, these couples meet the requirements for use to an acceptable degree. The most commonly used couples and suggested maximum temperature applications are as follows:

Positive	*Negative*	*Maximum Temperature, Deg F*
Platinum-rhodium	Platinum	3000
Chromel	Alumel	2000
Iron	Constantan	1650
Copper	Constantan	500

The potential generated as a function of temperature is shown for each of the metals used in making up these four thermocouples in Fig. 1. The curves are drawn so that platinum is used as a standard metal for comparison. The emfs of metals which are negative with respect to platinum are plotted as negative, while the emfs of metals that are positive with respect to platinum are plotted positive. The emf that will be developed by any combination of two metals may be determined by reading the vertical difference between the curves of the two metals at the proper temperature. The cold junction is assumed at 32 F. If the cold junction is at any other temperature, the difference between two values, one read at the hot junction temperature, and the other read at the cold junction temperature, will give the emf that will be generated. For example, what voltage would be generated by a chromel-alumel couple if the hot junction temperature is 1000 F. and the cold junction temperature is 200 F? The difference between the two curves at 1000 F is 23 mv, while the value for 200 F is 3.5 mv. Thus the

net voltage generated is 23 minus 3.5, or 19.5 mv.

The hot junction of the thermocouple usually should be prepared by twisting several strands of the two wires together and fusing them together at the ends. This connection should be made by either melting the ends of the wires together, or by welding, brazing, or soldering them together. In any case, the hot junction tip should be kept as small as possible, because an average temperature over the tip will be indicated, rather than the exact temperature at a given spot. As long as the whole tip is at the same temperature, the presence of a third metal or any number of additional metals will make no difference in the measurement of the true temperature. The choice of method for making the tip depends on the temperature at which the couple is to be used, the danger of corrosion of the couple wires or melting, and other similar considerations.

If the couple is to be used inside a duct, pipe, or vessel, either with or without a protecting tube, it should be made as described above, and as shown in Fig. 2A. If the temperature of the wall of a pipe or vessel is desired the thermocouple may be welded, soldered, or brazed directly onto the metal wall, as shown in Fig. 2B. The amount of metal used in securing the thermocouple to the wall of the vessel is not critical, as metals have high thermal conductivities, and the wall of a vessel over a comparatively wide area will be at substantially the same temperature. As long as the wires of the thermocouple are firmly embedded in the metal seal, it makes no difference whether the ends of the wires are touching. The metal seal will of course complete the electrical circuit, and the hot junction will function as though the wires were actually connected together. Likewise, a number of individual wires of composition different from either of the thermocouple wires could be connected in series and then used to connect the two hot junction leads. As long as all the junctions of the wires are at the same temperature, no error is introduced, as any counter emfs induced are canceled out from junction to junction. This same reasoning applies to connections at the cold junction, and it is here that this latter situation is encountered in actual practice. The cold junction in a temperature controlling process is located inside the controlling instrument, and the necessary wiring for proper functioning of the controller necessitates the inclusion of a number of different metals in the thermoelectric circuit.

The thermocouple proper, consisting of the hot junction and wires extending from it, must be repaired and/or replaced at not infrequent intervals. Consequently, it is general practice to lead the thermocouple wires into a terminal head. Within this terminal head, extension wires connecting the thermocouple with the temperature indicating or controlling instrument are placed. The extension wires are part of the thermocouple circuit, and thus must be of the same materials as the thermocouple wires, or of materials having the same temperature-emf relationship. If a controlling instrument is used, these external extension wires must be connected with internal extension wires leading to the cold junction. Since the thermocouple circuit is essentially an electric circuit, it follows that the wires should be insulated from hot to cold junctions. There are actually three thermocouples in this circuit, but since they are connected together, the net effect is that one thermocouple, extending from the hot junction to the cold junction, is present. This set-up is shown in Fig. 3, wherein a potentiometer is used as the indicating instrument. It should be pointed out that whenever the thermocouple leads are connected to leads of the same composition (e.g., copper leads from a selector switch to an indicating instrument), the cold junction is located at the connection point, and proper correction should be made. For example, if the internal extension wires inside an instrument were made of copper, the cold junction would not be inside the instrument, but at the point of juncture of the external extension wires with the internal extension wires.

Multiple arrangements of thermocouples may be used for various reasons. A number of thermocouples may be connected in series, either to provide a greater emf output, or to provide for greater sensitivity when dealing with small temperature changes. A specific application of the multiple series connection unit is known as a thermopile. Thermopiles consist of a very large number of thermocouples, and can be made very sensitive to small temperature changes. For example, some thermopiles are sensitive to a few ten thousandths of a degree. As shown in Fig. 4, the extension wires from each thermocouple should be extended to the cold junction if the voltage generated is to be a multiple of the voltage generated by one thermocouple. At any rate, all the extension leads should be withdrawn to a point of constant temperature for the sake of precision.

Parallel connection of a number of thermocouples is of value if an average temperature across a large pipe or vessel is desired. The desired number of thermocouples are installed over the required area or volume, and the couples are connected in parallel

FIG. 4. Series thermocouple connections.

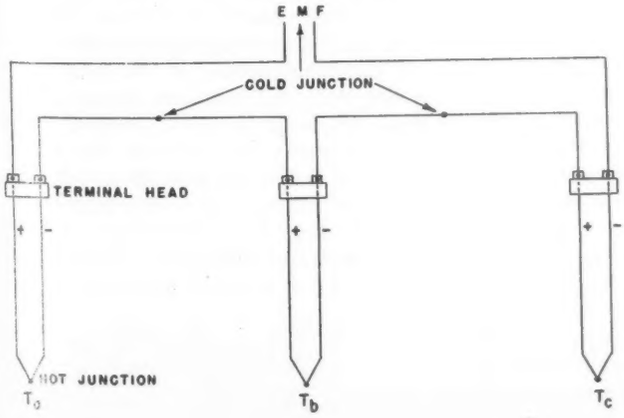
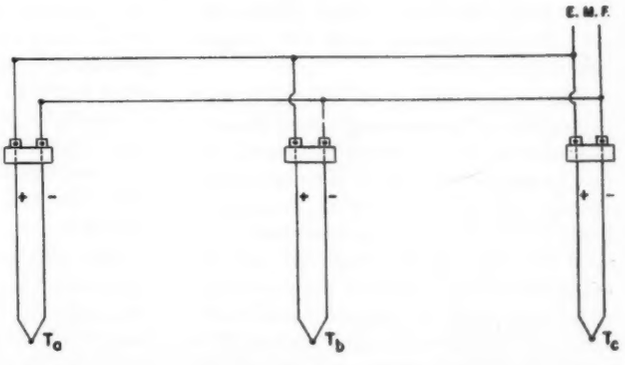


FIG. 5. Parallel thermocouple connections.



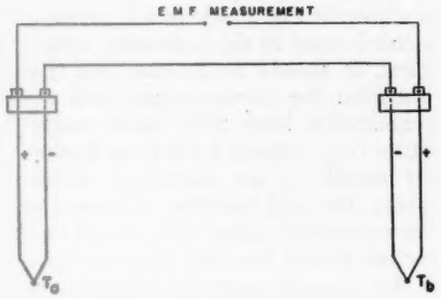


FIG. 6. Thermocouple connections for differential temperatures.

as shown in Fig. 5. All connections are made at the cold junction temperature. The voltage generated by this arrangement is the same that would be generated by a single couple at the average temperature, or is equal to the sum of the individual voltages, divided by the number of couples. Also

$$T\ avg. = \frac{Ta + Tb + Tc}{3}$$, if the

curves of emf vs. temperature are linear. The actual installation of the parallel set-up is complicated by necessary addition of "swamping resistors" when the temperatures are not equal at the various couples. This is done to equalize the resistances in the individual thermocouple circuits, however, the details of the application are beyond the scope of this article.

Two thermocouples may be used for measurement of differential temperatures between the two points of application of the couples. As shown in Fig. 6, the thermocouples are connected together with extension wires of the same materials of which the thermocouples are constructed. The connections are made so that the emfs developed oppose each other. Thus, if the temperatures Ta and Tb are equal, regardless of the magnitude, the net emf will be zero. When different temperatures exist, the voltage generated will correspond to this temperature difference, and the actual difference may be determined from the proper calibration curve.

The measurement of the emf generated by a thermocouple may be accomplished in a variety of ways. As can be seen from Fig. 1, the maximum voltage will probably be of the magnitude of 50 mv, with measurement of 0.03 mv increments required for an accuracy of 1 F. Among the many instruments used to measure millivoltages, the millivoltmeter, manually operated potentiometer, and the power operated potentiometer are the most common. All of these instruments must perform two functions satisfactorily:

1. They must measure the difference in emfs generated by the cold and hot junctions within the accuracy limits indicated. This is usually done by comparing the TC emf with some accurately known standard voltage. The well known Weston or cadmium amalgam-mercury cell which generates a constant voltage of about 1.0185 to 1.0195 volts is customarily used for this purpose.

2. They must provide a means of indicating the emf difference independent of fluctuations in the cold junction temperature and emf. Cold junction compensation is achieved by selecting some arbitrary base or reference temperature and considering that TC temperatures above and below the reference will generate positive and negative emfs, respectively. A set of tables or Fig. 1 may then be used to calculate the emf of the cold junction. This voltage added to the difference voltage will yield the emf of the hot junction with respect to the reference temperature.

A millivoltmeter is actually a high sensitivity d'Arsonval type galvanometer with the same type coil, permanent magnet, and suspensions described in any electrical handbook. This instrument draws a finite amount of current when operating and thus is subject to errors caused by voltage drops across the thermocouple and lead wire resistances. To eliminate this error, the millivoltmeter is calibrated for a specific type thermocouple and a specific value of total external resistance. Table 1 indicates the error that may be expected when a 10 or 500 ohm internal resistance millivoltmeter calibrated for 3 ohms external resistance is used on installations with 1, 3, or 5 ohms resistance. Corrections for variations in cold junction temperature are usually made by calibrating the millivoltmeter at a given cold junction temperature (around 80 F) and then computing errors caused by fluctuations in this temperature and correcting the indicated temperature. Automatic compensation may be achieved, however, by a bimetallic spiral mounted in the d'Arsonval movement to wind or unwind one of the coil suspension spiral hair springs the correct amount to adjust for cold junction temperature changes.

The null or balance type manually operated potentiometer shown schematically in Fig. 7 is a widely used means of measuring thermocouple voltages. Its main feature is a series of resistances (B, C, and D) across which a known voltage (e_{bb}) is impressed.

TABLE 1. Millivoltmeter errors.

Internal resistance	500	10
External resistance	(Error,	%)
1	+0.40	+18.18
3	0.00	0.00
5	−0.40	−14.33

This series of resistances contains a variable resistor or slide wire with a movable contact that is calibrated in terms of millivoltage versus position. If a galvanometer and a thermocouple are connected in series from X to the slide contact a balance may be achieved by moving the slide contact until the galvanometer deflection is zero. At this point the voltage indicated by the slide contact will be equal to that developed by the thermocouple and no current will be flowing through the thermocouple, leads or galvanometer. This feature makes the potentiometer independent of external resistances. Fig. 7 also shows the additional refinements of standardization and cold junction compensation circuits. Standardization is accomplished by connecting the galvanometer to the standard cell and adjusting the resistor (A) until balance is reached at the design value of e_{bb}. Care should be taken not to leave the circuit in an unbalanced position for extended periods of time during standardization; the excessive current drain would destroy the constant voltage of the standard cell. The resistor (F) is of the slide wire variety and is calibrated in terms of millivoltage versus contact position. It is set at the emf determined by the cold junction temperature and arbitrary base temperature and thus achieves manual cold junction compensation. Automatic compensation may be made by means of the circuit shown in Fig. 8. This type compensation depends on the fact that most materials have temperature coefficients of resistance, that is the resistance of a given quantity of material changes with temperature. Resistors A, B, C, D, and G are constructed from maganin, an alloy that has a zero temperature coefficient. Resistor E is constructed from nickel that has a high temperature coefficient. As the temperature of the potentiometer and cold junction changes, the ratio of E to E + G changes and consequently the voltage across E changes. If the compensation is to be effective the position of the slide wire contact must be independent of the cold junction temperature. These facts lead to the differential equation

$$\frac{de_{cj}}{dt_{cj}} = \frac{e_{bb}\ G\ dE}{G + E\ dt} = \frac{e_{bb}\ G\ dE}{dt\ (G + E)}$$

Where: $\frac{de_{cj}}{dt_{cj}} =$
rate of change of cold junction emf with cold junction temperature

$\frac{dE}{dt} =$
temperature coefficient of nickel resistor

Knowing the slopes of the emf and resistance curves, suitable values of the resistors E and G may be selected to provide automatic compensation. It should be noted that the resistor G or E will have to be replaced whenever a different thermocouple type is used.

In addition to the millivolt measurement, standardization, and cold junction compensation features discussed for a manually operated null type potentiometer, a power operated potentiometer must maintain a balance between the thermocouple emf and potentiometer emf by determining direction and magnitude of unbalance and making the necessary corrections. It must also provide an indicator movement or a chart and pen movement for recording purposes. Depending on the manufacturer, these functions are accomplished in theoretically similar but practically different manners.

One instrument is constructed with a needle or pointer type galvanometer and employs a number of mechanical parts which periodically clamp the galvanometer needle to determine the size and direction of any unbalance, and then repositions the slide wire contact in accordance with the deviation. This behavior may be disadvantageous in processes in which large temperature fluctuations might occur during the 3-second clamping period.

Another common type instrument uses a slide wire bridge but converts the d-c unbalance to a-c by means of a vibrator or converter, amplifies the voltage in a stable vacuum tube circuit, and then applies the voltage to a reversible motor which repositions the slide wire contact. The dead zone and/or time lag in this installation may be made negligible.

Most of the higher quality automatic instruments employ automatic cold junction compensation and automatic standardization of the types discussed.

In any installation employing thermocouples, it is a wise precaution to make sure the temperature indicated on the instrument is the temperature of the material in question. Excluding calibration, standardization, and cold junction compensation errors, there are two other major sources of error in thermocouple temperature measurement. These are a transient time transfer lag and a steady state heat transfer error.

A transient time lag may be caused by two different type occurrences. First, a material whose temperature is being measured may suddenly change temperature. Secondly, a thermocouple may be suddenly immersed in a material at a different temperature. These happenings result in the thermocouple and material being, at least temporarily, at different temperatures and indicate that a certain amount of heat must be transferred with a resultant time lag before the temperature difference or driving force can become zero or constant. This behavior is expressed by Newton's law of cooling.

$$\frac{L\,d\theta + \theta = U}{dt}$$

If U is a function of time only, the equation becomes a first order linear differential equation and the general solution may be expressed as

$$\theta = e^{t/L}\left[\int \frac{U\ e^{-t/L}}{L}\,dt + C\right]$$

where C is a constant of integration. This equation may be integrated for various functions of U in terms of t.

If $U = U_o$ (constant)

$$\theta = U_o + (\theta_o - U_o)e^{-t/L}$$

If $U = kt + U_o$ (linear function)

$$\theta = U_o + kt - kL + \left[\theta_o - U_o + kL\right]e^{-t/L}$$

If $U = U_o + A\,\mathrm{Sin}\omega t$ (sinusodial function)

$$\theta = C_1 e^{-t/L} + U_o + \frac{A}{\sqrt{L^2\omega^2 + 1}}\,\mathrm{Cos}\,(\omega t + \phi)$$

FIG. 7. Potentiometer circuit.

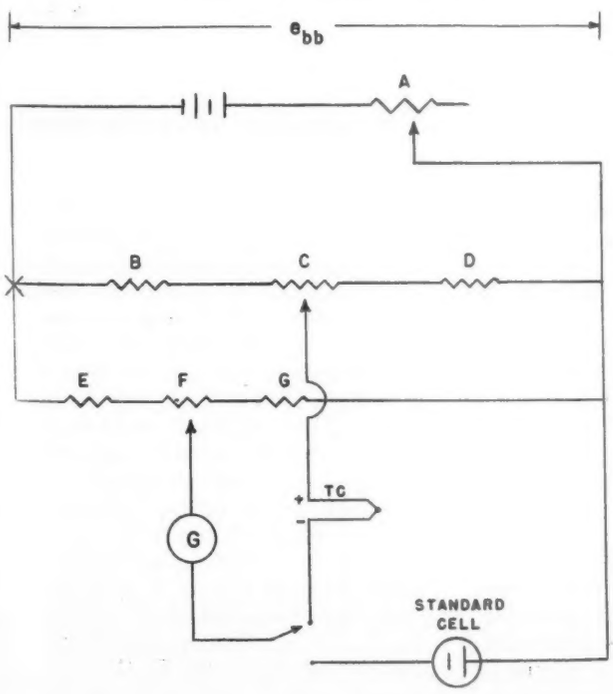
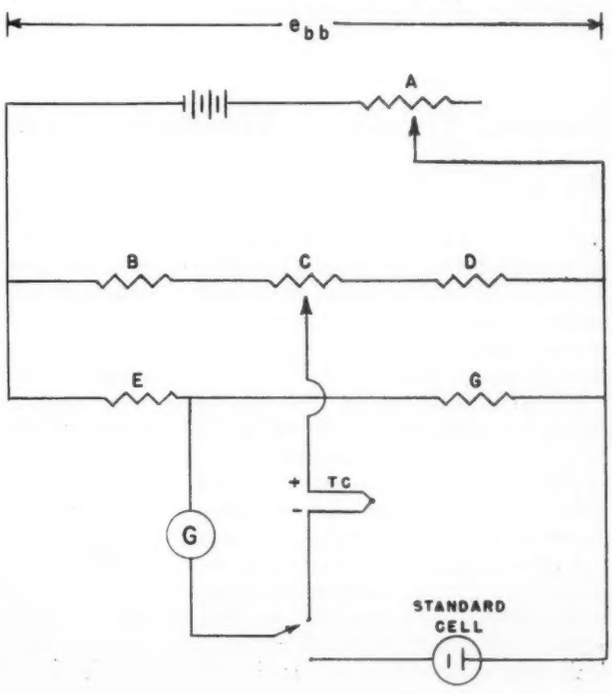


FIG. 8. Potentiometer circuit.



Usually the transient term, $C_1e^{-t/L}$, becomes negligible after a short period of time.

Lag coefficients are largely dependent on the actual method of installing the thermocouple. Eckman[1] lists the following average values of lag coefficients for thermocouples measuring air temperatures.

Installation	Lag Coefficient, min.
Bare	0.58
Glass Well	1.10
Porcelain Well	1.70
Iron Well	2.00

Temperature errors caused by time lags in a thermocouple and iron well installation such as illustrated in Fig. 9 may be as much as 10 to 20 per cent of the actual temperature if U is varying linearly with time.

The second type of error that may be encountered, especially in high temperature gas measurements, is one caused by steady state heat transfer. Reference to Figs. 2A or 9 will show that a large temperature gradient will exist between the hot junction of the thermocouple which is immersed in the hot fluid and the base of thermocouple which is usually at the temperature of the surrounding air. This temperature difference causes heat to flow through a film resistance to the hot junction and then through the protecting tube or thermocouple wires to the surroundings. The error in question is the temperature drop or driving force necessary to cause heat to flow from the fluid to the hot junction. Estimation of this error can be made if the heat transfer is by conduction and convection by use of the equation[2]

[1]Principles of Industrial Process Control—D. P. Eckman—Wiley (1945).
[2]Elements of Heat Transfer and Insulation—Jakob and Hawkins—Wiley (1942).

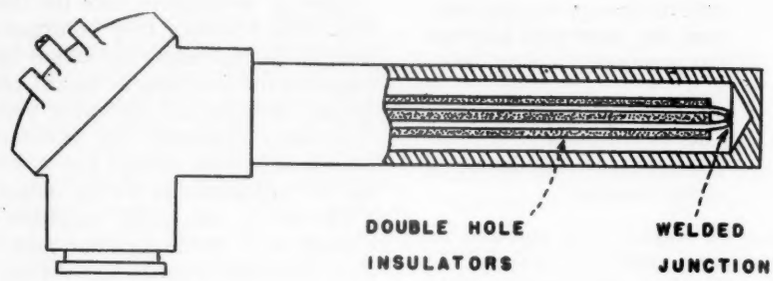


FIG. 9. Thermocouple in well.

$$T_g - T_t = \frac{T_g - T_o}{\text{Cosh}\left(L_t\sqrt{\frac{h_e C_t}{K_t A_t}}\right)}$$

If the heat transfer is primarily radiation and convection the following equation applies.

$$T_g - T_t = \frac{1723 e_t}{hc}\left[\left(\frac{T_t}{1000}\right)^4 - \left(\frac{T_w}{1000}\right)^4\right]$$

Where neither conduction nor radiation is negligible, an exact computation of the error would be very tedious. The maximum possible error that may occur can be calculated by computing the error caused by convection and radiation with conduction negligible and adding to this the error caused by convection and conduction with radiation negligible.

The literature shows that indicated gas temperatures in the region of 1200-2000 F may be in error by value of 100-600 F from the heat values of the estimated true gas temperature at couple.

Nomenclature

A—amplitude of cycle of actual temperature; b—period of cycle; C—constant; k—slope of U versus t function; L—lag coefficient; M—amplitude of cycle of indicated temperature; t—time; U—actual temperature; θ—indicated temperature; ω—$2\pi/b$; ϕ—lag angle $= \text{Sin}^{-1}\left(\frac{LW}{\sqrt{L^2W^2+1}}\right)$; T_g—temperature of gas; T_T—temperature of TC; T_o—temperature of base of TC; T_w—temperature of surrounding wall; L_t—length of TC from location of T_t to T_o; hc—convection coefficient between gas and TC; C_t—circumference of TC subject to convection; K_t—thermal conductivity of TC; A_t—cross sectional area of TC; e_t—emissivity of surface of TC.

* * *

National Bureau of Standards Issues Annual Report of Scientific Investigations

AN interesting summary of investigations in the physical sciences carried on at the National Bureau of Standards during the fiscal year 1948 is contained in a 272-page illustrated booklet published by the Bureau and now available from the U. S. Government Printing Office.

Scientific activities at the Bureau during the year were conducted by 13 divisions concerned with electronics, applied mathematics, atomic and molecular physics, radio propagation, electricity and optics, metrology, heat and power, chemistry, mechanics, organic and fibrous materials, metallurgy, mineral products, and building technology. A fourteenth division dealt with commodity standards. Of the numerous and varied projects carried out by approximately 100 sections within these divisions, those of greatest general interest and widest application have been selected as typical for description.

Included are the development of a magnetic fluid clutch having extensive applications and many unique features, research on resin-bonded papers, development of a proposed new standard of length based on the wave length of a mercury isotope, measurement of the magnetic moment of the proton, use of a new electron-optical technique for exploring electric or magnetic fields in space, investigations of automotive antifreezes, and further study of the properties of matter at very low temperatures. Space is given to extensive programs on nuclear radiations; high polymers; and aeronautics, including research on air turbulence at supersonic speeds, development of high-octane aviation gasoline, and the design of combustion chambers for gas turbines and jet engines. Research on housing problems also receives emphasis, particularly that of applying engineering principles to structural design.

Annual Report of the National Bureau of Standards for 1948 includes 272 pages, 39 half-tone illustrations, and is 25 cents a copy. It is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Sunbury Lubricating Oil Test Engine*

J. R. CROWTHER, T. E. PITKETHLY, R. STANSFIELD†

We acknowledge gratefully the fine cooperation of the Institute of Petroleum, Mr. George Sell, Editor, and Mr. Richard Stansfield of Anglo-Iranian Oil Co., Ltd., in providing us with original illustrations for this article, corrections for clarification of the manuscript and generous helpfulness throughout.—Editor.

CONSIDERABLE difficulty has been experienced when testing lubricating oils in engines, especially in the effort to obtain reproducible results. This problem has been intensified when attempting to duplicate results from different laboratories; only recently have a limited number of engines been obtained of suitable design for such work, and only recently has it been possible to lay down the conditions for standardized tests.

Use of engines commercially available, rather than of units specially built for testing purposes, has been the reason for much of the lack of success in oil testing in the past. Scaling down engine sizes has resulted in lowering the temperatures below those that the test proposed to simulate, and is responsible for much of the failure to secure the required results. Considerable testing experience has been obtained from work with the Caterpillar single-cylinder diesel engine, the Chevrolet six-cylinder automobile engine, and the G. M. 71 two-stroke, high-speed diesel, which are employed in testing oils for approval under U. S. Army specification 2-104B.

Accumulated experience showed urgent need for specially designed oil test engines that might differ widely in many respects from commercial prime movers, which would embody features found to control the significance of lubricating oil engine tests. Anglo-Iranian Oil Company Ltd. decided to design and manufacture a small number of prototype units for experimental work. The engine Tests of Lubricants Panel, I.P. Standardization Committee No. 5 agreed that a special engine was needed for tests of aviation lubricants and possibly for automotive lubricants in connection with bearing corrosion and similar tests. It also recommended a special diesel engine for testing heavy duty oil. The new Sunbury engine appears to meet the requirements of the first recommendation and as of April 1949 eleven such engines were being built.

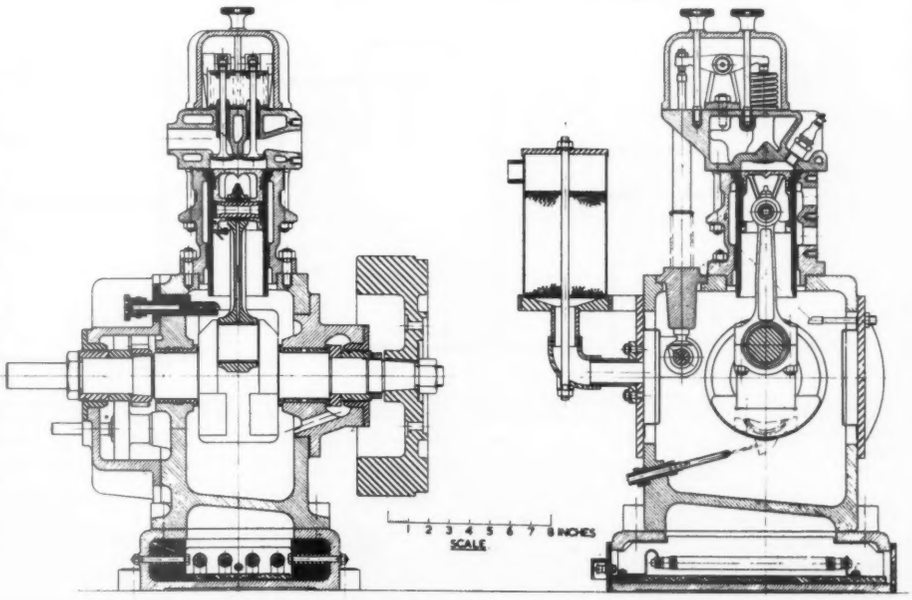
Requirements for such an engine are exacting. Wear on parts not replaced after each test run must be at a minimum, and new parts must be replaceable without any machining operations. Simplicity of construction and ease of dismantling are important, and auxiliary equipment should be mounted separately from the main unit wherever possible. Since breakdown of lubricating oils may be caused by high crankcase temperatures or by high cylinder-wall temperatures, with the resultant complications and deposits, a test engine must be fitted to operate over a wide range of temperatures. With proper temperature control features, a small test engine has been shown to give satisfactory ratings as regards bearing corrosion and can serve at least as a preliminary sorting unit for detergent oils.

In a commercial engine oil temperatures are determined chiefly by cylinder-jacket temperatures, running speed and operating pressure. Choice of a suitable list of coolants will increase the attainable wall temperatures but only in a few designs where evaporative cooling with ethylene glycol can be done. Supercharging can be used but is rarely permissible with standard engines. Steps were taken in the new engine to permit external heating of oil, supercharging, a wide range of speed control and high-temperature cooling. Cylinder liners of various thicknesses can be fitted, including double-wall liners with a stagnant air space within, to enable the operator to raise oil temperatures to any desired level without difficulty.

Details of Engine Design

The engine is four-stroke, with 2½-in. bore and 3¼-in. stroke, detachable

FIG. 1. General elevations of engine.



*(Editor's Note—This article is prepared from data submitted by the authors before the Institute of Petroleum, London, earlier this year—J. Inst. Pet., April, 1949).

†Anglo-Iranian Oil Company.

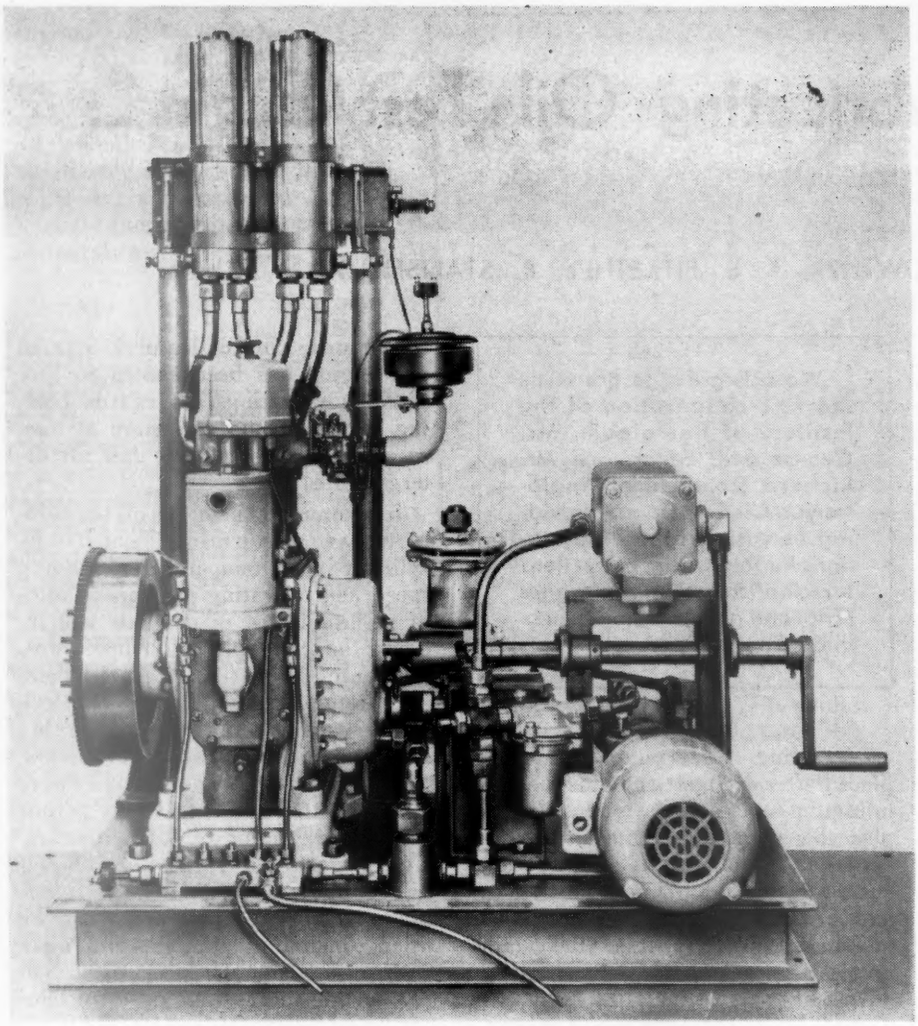
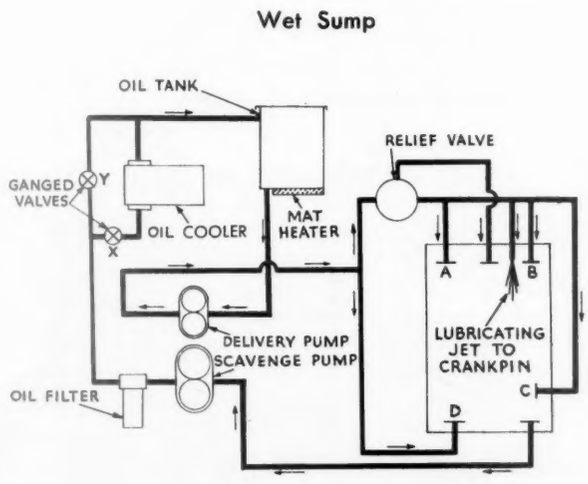


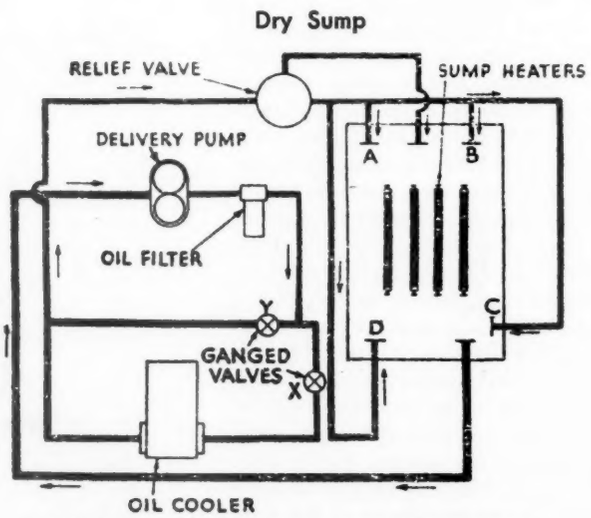
FIG. 2. Lubricating oil test-engine assembly.

overhead-valve cylinder-head and a flat combustion chamber. It is designed to operate at 100 lb bmep, and up to 3000 rpm when normally aspirated. It is so arranged that operation at 300 lb bmep and 2400 rpm can be employed, which will require a new cylinder head with inclined valves and the necessary more complicated valve-gears. The cylinder is a simple casting built to take a wet liner, the cast-iron crankcase is heavy, and all undesirable ledges and projections that make cleaning difficult are eliminated wherever possible. The case floor is sloped for easy drainage, and good oil flow when dry sump operation is employed. The crankshaft is made of nitriding-quality steel, is hardened and ground and the bearing surfaces super-finished. Timing gears are hardened steel helical wheels. A shaft driven at camshaft speed from that shaft is provided for use when both a magneto and a fuel pump are used. Three shafts extend from the engine's free end, the crankshaft and two half-speed drives, and are provided for operating auxiliaries when needed. This unit can be removed from the rest of the assembly along with the flywheel and carburetor with minimum disturbance. Engine and auxiliaries are mounted on a fabricated under-bed. A radiant-type heater is provided beneath the crankcase, and other auxiliaries include a motor-driven oil pressure pump, scavenger pump, oil filter and oil cooler. The design also supplies supports for magneto and fuel-injection pump, and a framework to support the condensers



1. *Full heating.* Valve X closed, Y open, sump heaters on.
2. *Full cooling.* Valve X open, Y closed, sump heaters off.

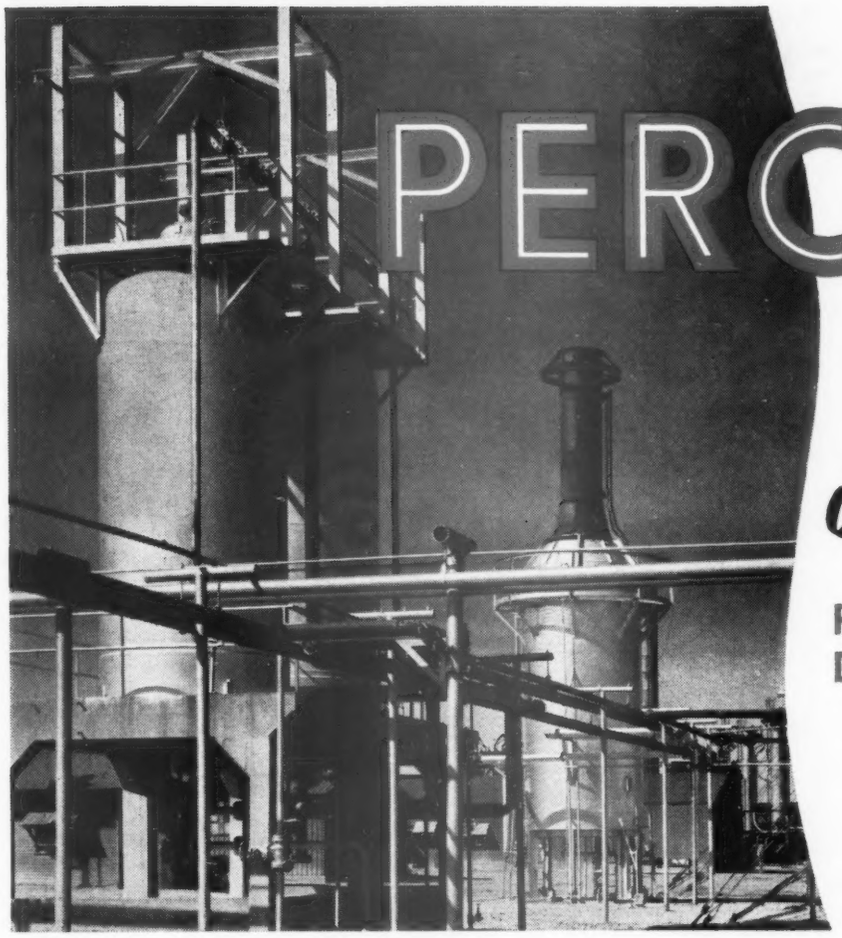
Lubricating jet to crankpin is alternative to forced feed. Cooling jet to piston is optional in latter condition.



1. *Full heating.* Valve X closed, Y open, heating mat on.
2. *Full cooling.* Valve X open, Y closed, heating mat off.

Lubricating jet to crankpin is alternative to forced feed. Cooling jet to piston is optional in latter condition.

FIG. 3. Lubrication system.



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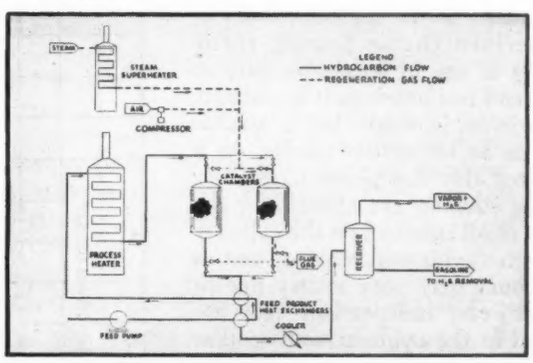


Perco Catalytic Desulfurization Process

Phillips 66

PHILLIPS PETROLEUM COMPANY

PERCO DIVISION • CHEMICAL PRODUCTS DEPARTMENT

BARTLESVILLE, OKLAHOMA

PROFIT WITH PERCO PROCESSES

for cylinder-head and jacket coolants is provided. Engines will be run with carburetors designed for control of mixture strength. Power will be absorbed by a water-brake, although a fan brake may be used for routine work, after the procedure has been developed. Inlet air is cleaned by an oil-bath type cleaner fitted to the carburetor, and provision is made for measuring crankcase blowby, and for controlling the oil level in the crankcase.

Lubrication System

The accompanying Fig. 3 shows the various methods for lubricating the engine. This system includes a wet-sump arrangement with pressure feed, a splash-jet method for lubricating the connecting-rod big-end bearing, and a dry-sump system for testing aircraft engine oils. Using the wet sump system, oil is drawn through a line from the lowest part of the crankcase to a motor-driven pump with a capacity of 300 gal per hr, through a full-flow filter if required, a straight tube cooler with bypass arrangements, and to a piston-type relief valve that returns any excess oil to the sump. Outlet oil from this relief valve goes to various engine points. With full-pressure lubrication, a connection is taken to the timing-gear-end main bearing and an oil supply is led through the drilled shaft to the connecting-rod big-end and through the hollow rod to the little-end. Oil passes from the main bearing feed to two jets in the timing-gear casing and is sprayed between the gear-teeth. These jets may be used to aerate the oil. Oil is fed separately to the camshaft bearings and rocker arms, and to the flywheel-end main bearing.

One factor in the reproducibility of the Chevrolet engine bearing corrosion test is use of splash-jet feed to the big-end rod bearings it is claimed, so provision is made for a similar system as an alternative choice. As it is believed also that piston lacquering and ring sticking are affected by the amount of oil splashed on the cylinder wall from the big-end bearing, and as this amount may vary widely due to bearing wear, independent jets are provided in the cylinder wall so that any amount of oil may be supplied under control. Oil level in the crankcase is regulated by a "chicken-feed control" connected to the sump. A trap in one of the crankcase doors is connected to a blowby meter. For dry-sump work, a scavenger pump of 450 gal per hr and a pressure pump driven by the same motor are provided, employing an external oil reservoir. All lines are of steel to avoid the catalytic effect of copper.

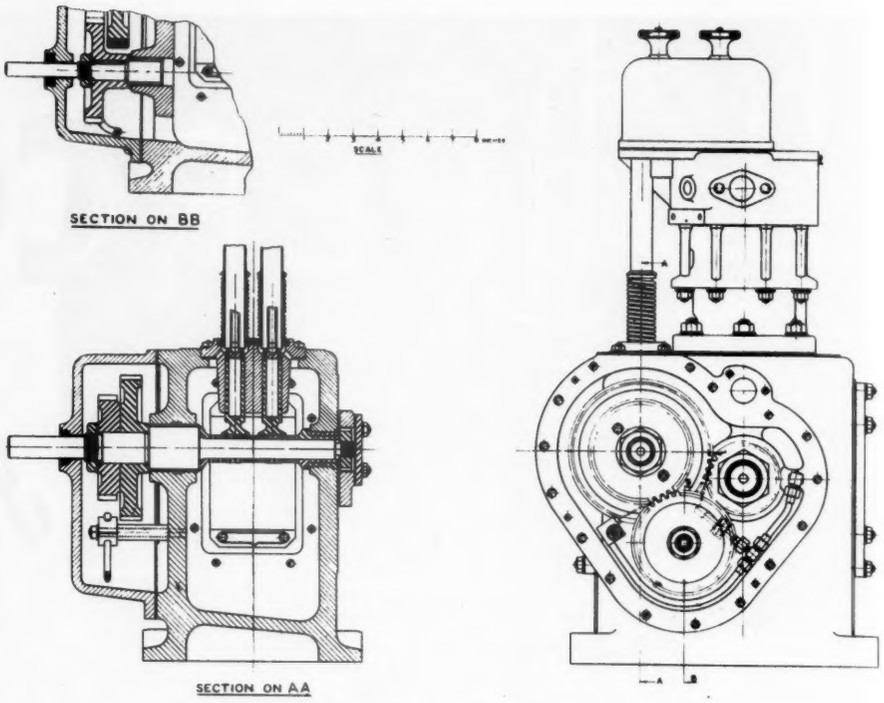


FIG. 4. Arrangement of timing gear.

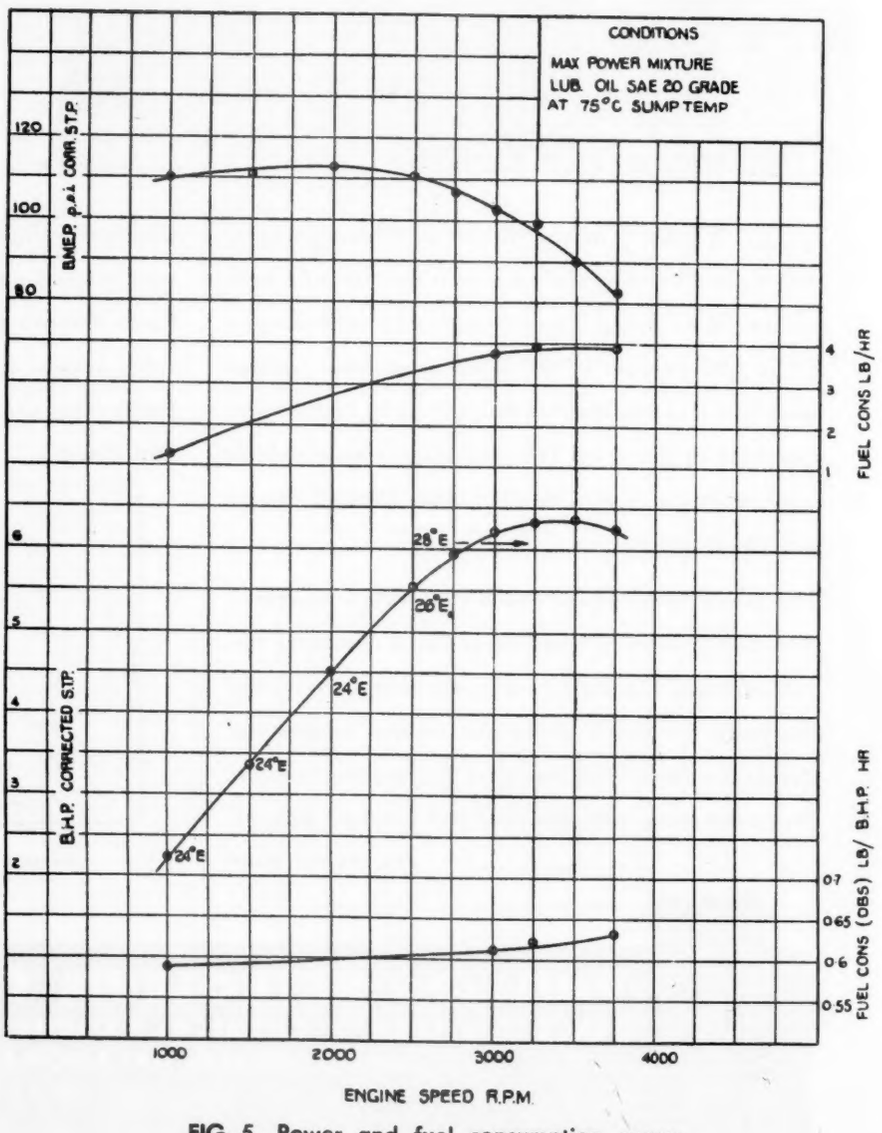
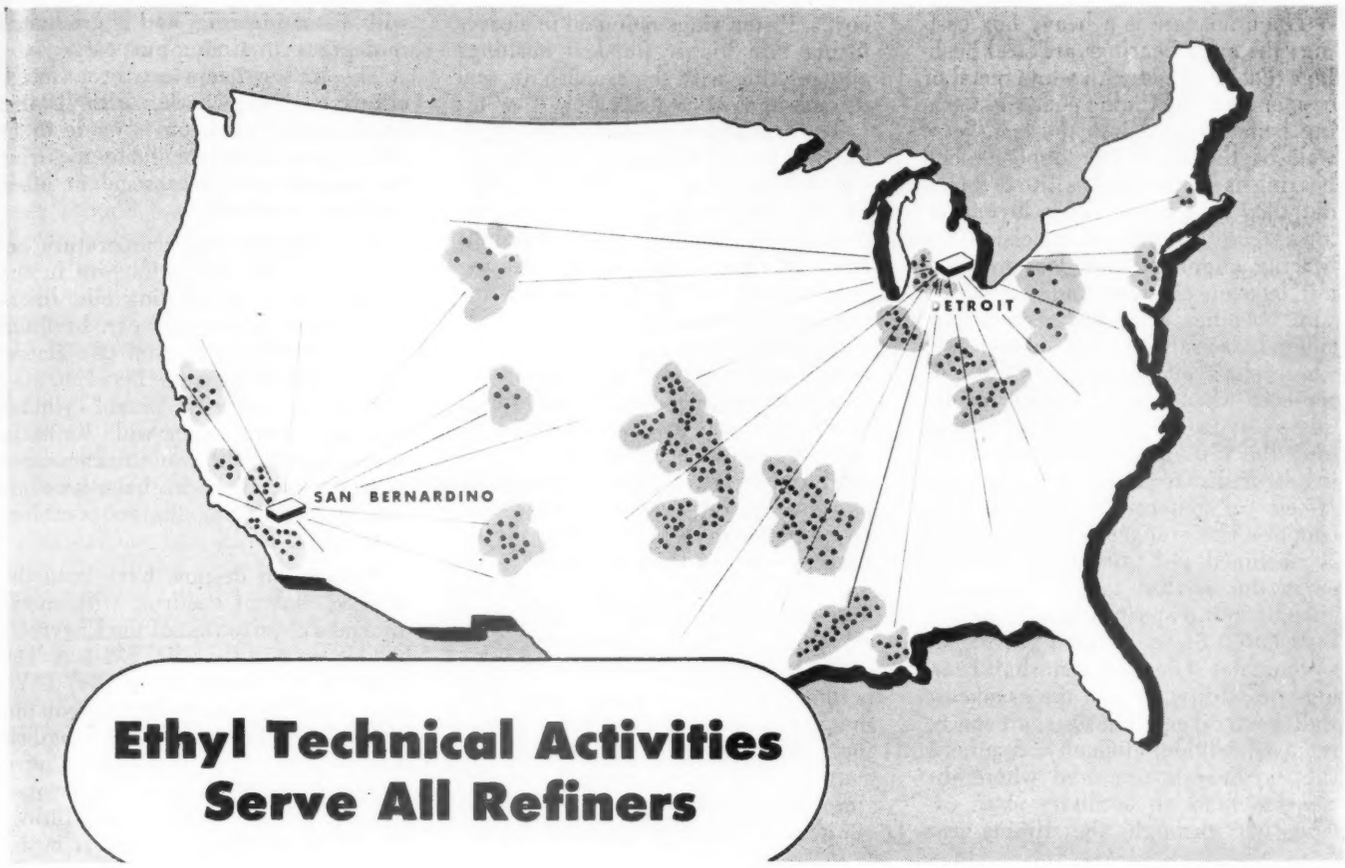


FIG. 5. Power and fuel consumption curves.



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2. Preventing Engine-Fuel Problems

After gasoline has been made, it must operate satisfactorily in many types of engines. Working with the manufacturers, the Ethyl Laboratories make every effort to help correct, before production, any features of engine design not likely to be compatible with the products offered by refiners.

3. Creating Mechanical Octane Numbers

Convinced that Ethyl's interests are inseparable from those of its customers, the Laboratories render an indirect but important service to oil companies by developing features of engine design which improve power and economy without requiring higher antiknock quality. Work is done on improvement of combustion chambers, and manufacturers are assisted in the development of intake manifolds which provide faster warm-up and better distribution of fuel to the cylinders.

4. Multiplying the Benefits of Research

The value of information developed by research is not lost through usage, but becomes more valuable as more people employ it. Without Ethyl's broad research program, individual oil companies might find it necessary to carry on many of the expensive research services now conducted by Ethyl.

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The crankcase is a heavy box casting; the main bearings are steel bushings that are lined with white metal or copper-lead, the timing gear-end bushing being pressed into the transverse wall of the case. The opposite end bearing is in two pieces fitted into a dowelled end cover. This layout allows a high degree of precision for bearing alignment but does not permit bearing clearance adjustment as split bushings do, which is not considered desirable in an oil-test unit where shaft and bushings should be replaced when wear is enough to permit excessive clearance. The casting over the timing-gear-end main bearing is drilled to admit a "retractable system" of contacts for piston thermocouples. The crankcase upper surface is machined and fitted for a block to carry the vertical tappet rods, with enough extra space allowed for the installation of an inclined valve gear system later if desired. Camshaft bearings press directly into the crankcase walls so arranged that the shaft can be removed without difficulty. Synthetic rubber oil-seals are used where the camshaft and an auxiliary shaft extend out through the timing-gear cover. Piston rings mounted in sleeves fitting into highly finished bushings and rotating with the crankshaft, seal its ends against oil leakage.

The crankshaft is fitted with balance weights bolted to webs; journals are nitrided, ground, and superfinished. The flywheel fits on a taper beyond the thrust collar lock nut. The crankshaft free end extends through the timing-gear cover to be used for hand starting or as an auxiliary drive.

Equipped with large bearing surfaces to reduce wear to a minimum, the crankshaft receives oil from a hole in the crankcase to an annular groove surrounding the bearing bushing, and the bushing is drilled to admit oil to a groove inside. From this groove oil passes through a hole drilled in the shaft to lubricate the rod big-end bearing, and through the hollow rod to little-end. When using the splash system this rod oiling system is plugged.

The crankshaft is drilled also to permit installing a thermocouple in the shaft under the surface of the journal, for temperature control, the couple leads being attached to slip-rings for contact with the indicating equipment. The flywheel can be fitted with a starting ring, and is graduated in degrees for timing purposes.

The timing gears are broadfaced, single-helical wheels, with 10-deg helix angle. Provision is made to fit other gears to make a one-to-one drive for an indicator attachment or other auxiliary connection.

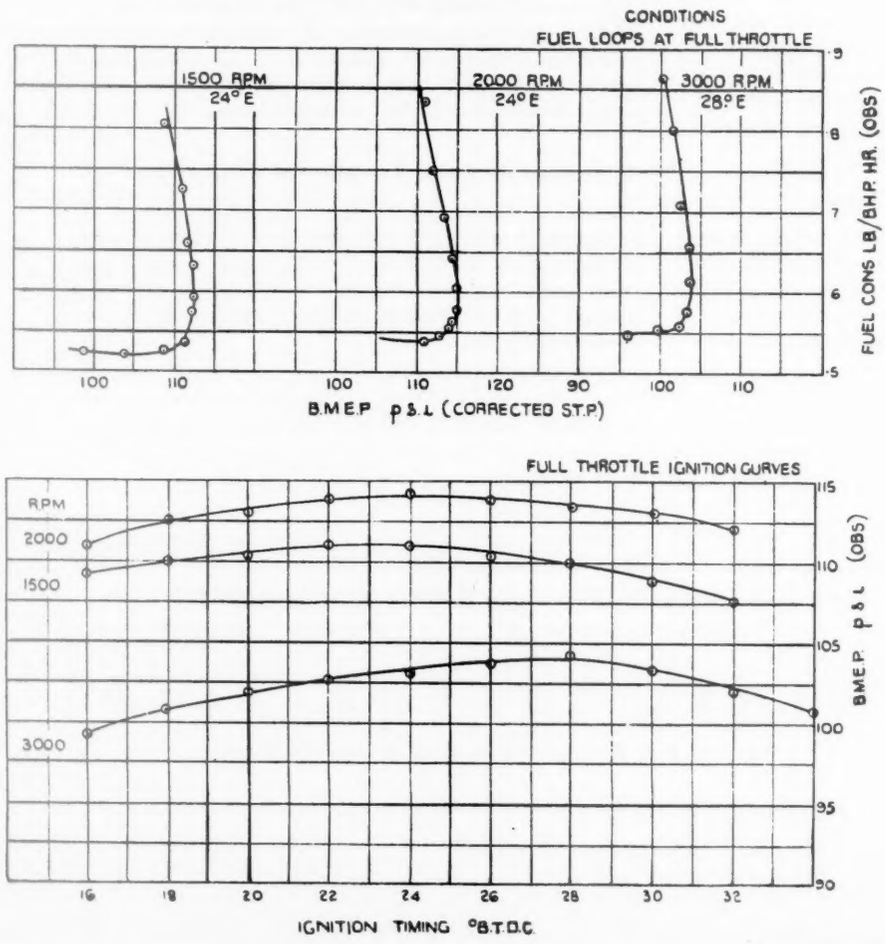
The cylinder wall temperature being one of the major factors in the breakdown of lubricating oils, liners of different thicknesses can be fitted to the cylinder, and even two liners, with a narrow air space between, may be fitted, in order to control cylinder wall temperature over wide limits in testing. Liners with wall thicknesses of 7/32 in. and 5/16 in. have been arranged for, during the test development work.

Two piston designs have been developed, one of castiron with metal thickness close to that of the Chevrolet pistons used in the CRC L-4 test. The other piston is made of an alloy ("Y" alloy), and both have the gudgeon pin mounted farther below the ring-belt than is customary in order to give plenty of room above it for lacquer deposits and to reduce piston tilting. Two thermocouples may be set in the pistons when required, one near the center of the crown and the other just behind the top ring groove.

The cylinder head is bolted to the cylinder by long studs screwing into bosses on the head and extending downward through a flange cast on the cylinder. This leaves the head free for valve springs, valve rocker gear and valve-gear cover. Valves seat on inserts in the headcasting, and valve guides can be replaced. The exhaust port is so arranged to deflect the gases away from the lower end of the exhaust valve guide, for best operation on leaded fuels. Chrome-constantan thermocouples for the pistons have been tested, and are situated behind the top-ring belt in the crown or wherever they are wanted. An ingenious arrangement of contacts is provided to connect these couples to outside indicating equipment. The oil level in the crankcase is maintained approximately constant by connecting the sump with an outside glass cylinder containing make-up oil that over-flows into the case. To prevent introduction of errors in oil consumption caused by oil being carried out of the case by vapors and gases, an oil-trap is situated in one of the crankcase doors, through which these escaping gases must pass through a 5-in. layer of glass packing beads enroute to the blowby meter.

Separate condensers are supplied for cylinder jacket and head-jacket so that water may be used in the head,

FIG. 6. Fuel consumption and ignition timing curves.



always, while the coolant in the cylinder-jacket is chosen with a boiling point to maintain the required cylinder wall temperature. Employing large connections to insure free liquid flow, the cooling coils in the upper part of these condensers fit into an annular space around a central tube, with a fill cap at the top of this tube. Two coils are wound helically, the outer being coupled with the inner coil by a cone-union connection at the bottom, the whole construction simplifying operation and permitting easy replacement of the coils.

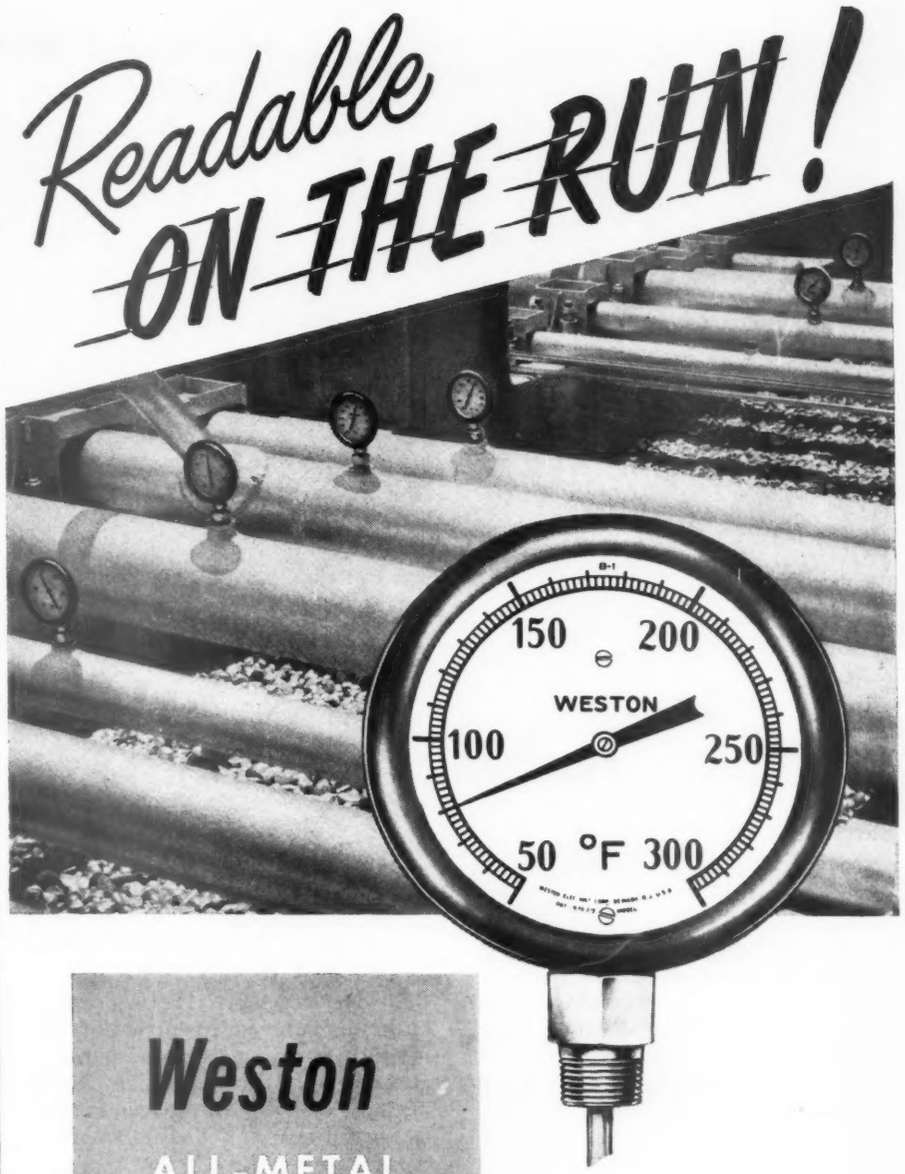
The carburetor is a Solex Type 26-AHD with adjustable jet to control air-fuel ratio. An A-C oil-bath-type air-filter is installed in the inlet; previous experience has shown that piston ring and cylinder wear results can be duplicated only if the air is cleaned thoroughly. The magneto is a BTH KD1, Form C6T.T. replica mounted on a separate external bracket, driven from the camshaft's projecting end through a rubber-sleeve coupling.

Test Performance

For the first engine of this design the brake mean effective pressure is 113 psig at about 2000 rpm, and maximum power occurs at about 3300 rpm when break mean effective pressure is about 96 psig. Power, fuel consumption, and ignition timing curves are shown in the accompanying Figs. 5 and 6. The engine meets the requirements of the original design for running at normally aspirated bmep of 100 at 3000 rpm. Full throttle fuel consumption varies from approximately 0.57 lb per bhp per hour to about 0.60 lb at the point of maximum horsepower output. The engine compression ratio is 6:1. From Fig. 3 it may be seen that spark advance for maximum power is affected only slightly by speed. A 100-hour type test has been passed by the unit, at 3000 rpm and 100 psig bmep, and plans are laid to use the engine to find out if conditions can be found suitable for rough sorting tests preliminary to the Chevrolet L-4 and the Caterpillar L-1 procedures, and also to replace the R. G. 2 aviation lubricating oil test. * * *

Ohio Oil Gets Safety Award

For operating without a lost-time accident from November 25, 1938, to January 1, 1949, for a total of 750,000 man-hours, the Lovell refinery of The Ohio Oil Company has received the United States Bureau of Mines' Joseph A. Holmes safety association certificate. J. C. Donnell II presented the certificate to the Lovell refinery superintendent, Bert B. Miller.



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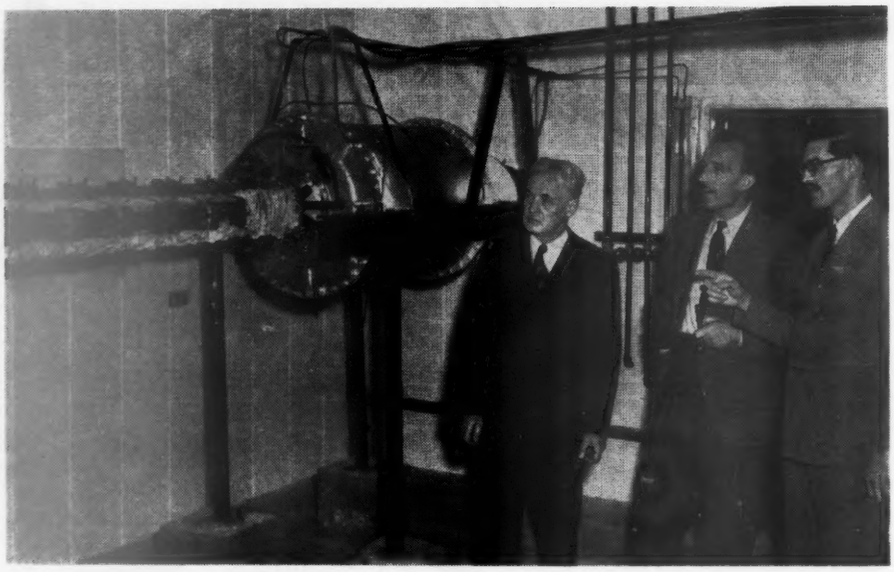


Dr. W. H. Brittain, vice principal of Macdonald College, McGill University; Dr. F. Cyril James, principal and vice chancellor of McGill University; and Professor Donald L. Moodell, director of gas dynamics research laboratory, inspect new gas turbine experimental fuel burner.

Gas Turbine Research

HARRY CHAPIN PLUMMER

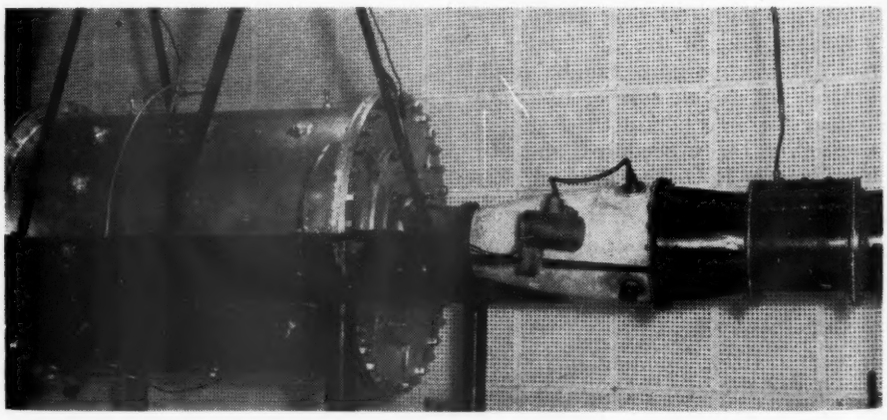
CANADA'S first organized study of combustion in gas dynamics is under way in a former armory on the campus of Macdonald College, at Sainte Anne de Bellevue, Quebec, 20 miles west of Montreal. It is being conducted by 29-year-old Donald Louis Mordell, associate professor of mechanical engineering at Montreal's McGill University. The purpose of the research and experimentation is to seek the cheapest and most efficient use by combustion of heavy and crude oils in operating railway locomotives, motor-cars and truck, jet-propelled aircraft and home fuel-burners.

W. H. Brittain, vice principal of Macdonald College, and F. Cyril James, principal and vice chancellor of McGill University, and a group of press representatives attended a demonstration of the apparatus installed by Professor Mordell, at Ste. Anne de Bellevue, recently. The laboratory, built this summer by private financing, is to continue research operations at the behest of the Canadian Government, principally for the benefit of the Defense Research Board and the Royal Canadian Air Force.

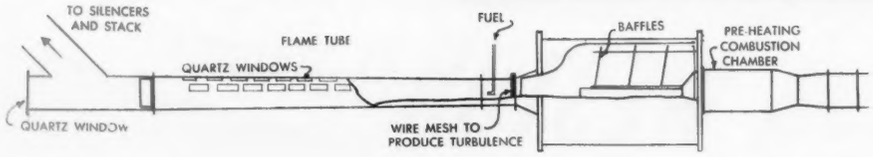
Professor Mordell outlined for *The Petroleum Engineer* the major objectives of the laboratory work, stating that the chief interest was in combustion and in the development of some fundamental research on hydrocarbon combustion, primarily relating to the utilization of the gas-turbine engine. "As such," he said, "an important part of our program will be an investigation of the properties of fuel oils. We have installed the equipment and the work we are presently doing is preliminary runs and calibrations and using standard aviation turbo-fuel. But we are going to extend that to cover heavier oils and particularly heavy Canadian oils.

"One of our set-ups is devoted to the spontaneous ignition of fuels in a hot flowing air-stream. In the apparatus ignition and combustion take place at essentially constant pressure, as distinct from the usual bomb-type of test, and will permit us to investigate ignition and pre-combustion activities in much more detail than would be possible in a bomb test. Particular aspects being investigated are the effect of air-turbulence, temperature, and pressure of the fuel properties upon combustion. And there is the necessary preliminary calibration and checking of the apparatus.

"In other test rigs we are investigating the behavior of various types of fuels in gas-turbine combustion-chambers. We have been doing this work for the past year and our new laboratories, just opened, will permit a considerable expansion of the program. As far as I know, this is the only laboratory of the sort in Canada —the first devoted to combustion and gas dynamics research within the Dominion." * * *



This sketch shows rig in an earlier form. Air supply to preheating chamber is now obtained from a Merlin engine-driven compressor. Settling tank and baffles produce a homogeneous, turbulence-free air stream for experimental flame tube, in which combustion occurs purely by spontaneous ignition. No flame holders are used. Progress of combustion may be inspected through the quartz windows, which permit also spectroscopical investigation.



Air is delivered by a compressor in a room at the right hand side to 'slave' combustor (light conical tube). Here air is heated to 1500-2500 R by internal combustion. Large tank is a stainless steel lined surge tank, having perforated baffles in it.

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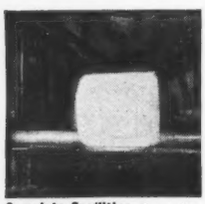

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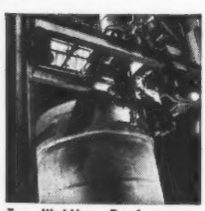

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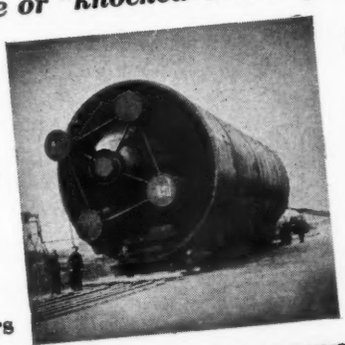

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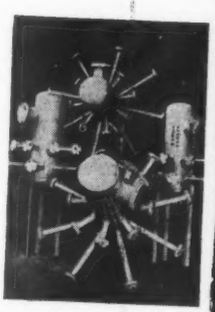

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THE TECHNICAL FORUM

Clearinghouse of Technical and Chemical Engineering Know-How for Men in Refining and Gas Processing

Q **Show how to calculate the rate of total heat transfer—heat loss—per hour through a conventional furnace wall with four or more layers of material, such as is used in thermal cracking or atmospheric distillation service. Assume any conventional dimensions, temperatures, etc.**
—A. D. Jenke, Jr.

A *Assumptions:* Conductivity—k = Btu/hr/sq ft/°F/ft thick

	Ave. Temp. °F	k
Wall made up of 9 in. firebrick	1360	.69
2½ in. Insulating firebrick	1025	.158
1½ in. Superex Insulating block	560	.061
3¾ in. Red Brick	200	.50

Temperature on hot side—1500 F
Temperature on cool side— 120 F

Calculations

Resistance = the reciprocal of the conductivity = $\frac{1}{k}$

Resistance of wall = sum of all of the individual resistances which are dependent on the actual thickness in feet of each section.

Resistance—9-in. firebrick

$$\frac{1}{.69} \times \frac{9 \text{ in.}}{12 \text{ in.}} = 1.088$$

Resistance—2½-in. Insulating firebrick

$$\frac{1}{.158} \times \frac{2.5 \text{ in.}}{12 \text{ in.}} = 1.318$$

Resistance—1½-in. Superex block

$$\frac{1}{.061} \times \frac{1.5 \text{ in.}}{12 \text{ in.}} = 2.050$$

Resistance—3¾-in. red brick

$$\frac{1}{.50} \times \frac{3.75 \text{ in.}}{12 \text{ in.}} = 0.625$$

Total resistance 5.081

$$\text{Conductivity} = \frac{1}{5.081} =$$

.197 Btu/hr/°F/sq ft for this assumed wall.

Total temperature drop — 1500° — 120° = 1380°F.

Heat loss = .197 × 1380° = 261 Btu/hr/sq ft for this assumed wall.

The above selected conductivities have been assumed to include the allowance for joints between sections of the wall. Care must be taken to select the conductivities at the average temperature of each material. This may require some trial and error calculations.—*Frank H. Praeger.*

Q **What are the properties of natural gasoline adsorption oil that are considered most important in present-day practice?—NGAA.**

A The properties of absorption oil for the recovery of hydrocarbons from natural gas are determined by the nature of the operations, which may be generally described by the operating pressure and the recovery efficiency of a specified marginal component of the gas.

Present-day natural gasoline operations differ from those of yesteryear in that much higher pressures are employed and higher recoveries of lighter hydrocarbons are desired. These differences frequently add up to different absorption oils.

The components of natural gas are largely paraffinic hydrocarbons with some olefins and diulted by nitrogen, hydrogen, etc. Absorption oil should recover some and reject other components. An ideal oil would absorb the butane (or propane) and heavier components, while rejecting the propane (or ethane) and lighter components, making a sharp cut between the *desired* and *unwanted* components. In actual practice small amounts of the unwanted components are also recovered. The most selective absorbent possible should be used. In speaking of selectivity of an absorption oil, we mean the relative recovery of (say) butane and methane, i.e. maximum recovery of butane for given retention of methane, or the minimum retention of methane for a given recovery of butane.

Natural gasoline operations have changed in many respects during recent years. The LPG business has increased the demand for propanes and butanes. These hydrocarbons are also

IF YOU WISH TO LEARN, ASK QUESTIONS!

One of the conditions that keeps refining technologists and operators on their toes is the rapid advances in their fields and the constantly increasing number of problems that they face.

Every reader of *The Petroleum Engineer* has problems on which additional information is needed. Send in your questions on any of these problems to

Technical Forum Editor,
Petroleum Engineer,
P. O. Box 1589,
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The most capable panel of authorities ever assembled by an oil publication is waiting to give the best answers to these questions that can be found anywhere in short scope; each answer is prepared for us and you by one of the most outstanding technical leaders in the industry. And it costs you exactly nothing but a postage stamp, paper, and the writing of the question.

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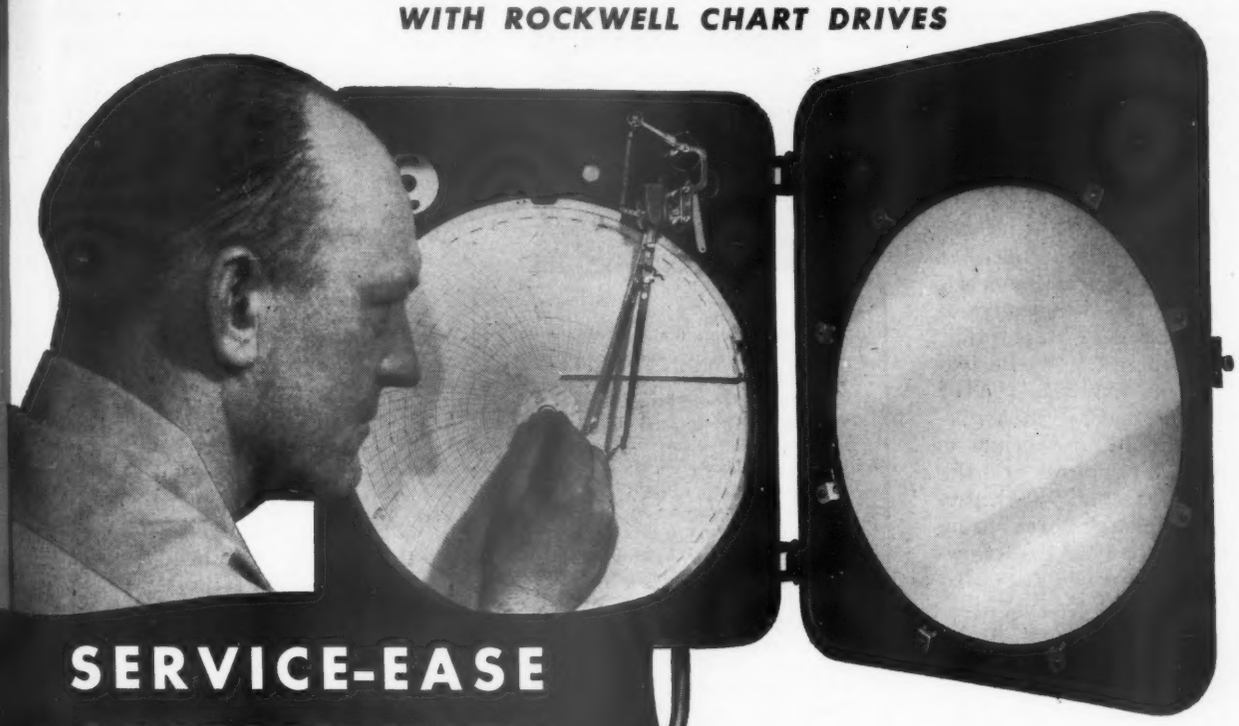
ORIFICE METER GAUGES

WITH ROCKWELL CHART DRIVES



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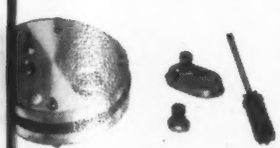
ROCKWELL CHART DRIVES



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in demand as raw material for synthetic chemicals manufacture. Thus, many hydrocarbons that were formerly rejected to fuel or burned in flares are now recovered as liquid products.

Another development has been "cycling' as a method for producing distillate wells. Gas cycling plants operate at very high pressure, as determined by the well pressures, to avoid all unnecessary gas compression and decline in the well. Cycling plant pressures of several thousand pounds per square inch are a far cry from the pressures of several atmospheres used in ordinary gasoline plants. A lean oil that is fairly selective between methane and propane at moderate pressures may not be as selective as some other oil at higher pressures.

C. G. Kirkbride and J. W. Bertetti (Ind. & Eng. Chem, *35*, 1242 (1943)) made some experimental measurements of vapor-liquid equilibrium in natural gas-lean oil systems at prestures between 1000 and 3000 psia and atmospheric temperatures, using three different lean oils of the following properties:

	°API	ASTM 10%	ASTM 50%	ASTM 90%	Mol Wt	Mols/ 100 gal
Paraffinic.....	35.9	504 F	532 F	583 F	230	3.05
Aromatic.....	9.3	489	513	650	160	5.22
Naphthenic....	31.1	501	536	616	220	3.30

These authors concluded from their data that the aromatic and naphthenic lean oils were more selective between pentane and methane than was the paraffinic lean oil. They also found that lean oil losses would be lower with the aromatic lean oil than with the paraffinic lean oil.

These conclusions are of particular interest in this connection because selectivities of paraffinic and aromatic lean oil are the opposite at low pressures, i.e. a paraffinic lean oil will absorb less methane for a given recovery of pentane.

In addition to the selectivity effect, there is a "moles/100 gallons" difference for different oils. While the amount of lean oil supplied to an absorber is measured in gallons of liquid volume, the absorbing capacity of that oil is determined by the number of moles circulated. It is therefore best to use an oil that has as many moles per 100 gallons as possible, consistent with volatility and other requirements. High API gravities and/or low molecular weights are desired.

The distillation ranges for the three oils used by Kirkbride and Bertetti were about the same and yet the moles/100 gals was much greater for the aromatic oil. For two oils of the same source, namely Mid-Continent virgin stocks, the following comparison indicates that the heavy naphtha contain 42 per cent more moles per given liquid volume.

NEW PANEL MEMBER

Research consultant on natural gas and chemical engineering and director of the division of engineering at Texas College of Arts & Sciences, Frank H. Dotterweich has experimented and worked with fuel gas in its numerous phases practically all his professional life. Since graduation with the BS degree in engineering from Johns Hopkins University in 1928 he has served in verious capacities with the Consolidated Gas interests of Baltimore, then returned to Johns Hopkins as a physical education instructor and to work toward the PhD degree, which he received in 1937. He joined Texas E & I College at Kingsville immediately, and in 1947 was made division director. From 1942 to 1945 he was consultant to PAW.

	°API	ASTM 10%	ASTM 50%	ASTM 90%	Mol Wt	Mols/ 100 gals
M. C. gas Oil..	35.5	512 F	570 F	663 F	247	2.86
Vir. hvy naphtha	49.2	318	340	380	160	4.08

In this case the heavy naphtha is more volatile so lean oil loses would be higher. To offset this, the gas from the main absorber may be put through a small sponge oil section, using a heavy oil, for the recovery of the main light oil.

This scheme is frequently used in plants where the lean oil is a heavy fraction of the recovered gasoline. This method has the advantage of continual renewal of the lean oil stream, which avoids the necessity of any rerunning or other treatment of the lean oil.

In conclusion, it is best to use as light an oil as possible and to add a small after absorber to recover lean oil. At high pressures the lean oil should be aromatic. At low pressures the lean oil should be paraffinic.—*Wayne C. Edmister.*

Q What is the chemistry of sweetening gasoline with lead sulphide PbS?—W.R.A.

A The chemical reactions shown here are generally accepted in the petroleum industry as being representative of the reactions that occur in doctor sweetening and doctor regeneration. Those shown relating to PbS sweetening are not so well defined, as in doctor sweetening, but they do indicate one reasonable explanation of the total overall reaction.

Plumbite Method

1. $PbO + 2NaOH \rightarrow Na_2PbO_2 + H_2O$
2. $2RSH + Na_2PbO_2 \rightarrow (RS)_2Pb + 2NaOH$
3. $(RS)_2Pb + S \rightarrow R_2S_2 + PbS$

Doctor Regeneration

4. $2PbS + 2O_2 \rightarrow PbS_2O_3 + PbO$
5. $PbS_2O_3 + 4NaOH \rightarrow Na_2PbO_2 + Na_2S_2O_3 + 2H_2O$
6. $PbO + 2NaOH \rightarrow Na_2PbO_2 + H_2O$

PbS Process

7. $PbS + \frac{1}{2}O_2 \rightarrow PbO + S$
8. $PbO + 2NaOH \rightarrow Na_2PbO_2 + H_2O$
9. $2RSH + Na_2PbO_2 \rightarrow (RS)_2Pb + 2NaOH$
10. $(RS)_2Pb + S \rightarrow R_2S_2 + PbS$

Upon examination of this series of reactions, it is seen that the lead sulphide acts substantially as a catalyst which enters into the reaction and is regenerated and that the net reaction of the series is one of oxidation as follows:

11. $2RSH + \frac{1}{2}O_2 \rightarrow R_2S_2 + H_2O$

J. A. Altshuler.

Q How may the color stability of (thermally) cracked kerosines be stabilized more effectively? —C. W. Berger.

A The question is not clear. Is kerosine meant, or is reference had to domestic fuel oil (of approximately kerosine boiling range)?

For kerosine (to be used in either lamps or stoves), it will prove best to treat with 66-deg Be sulphuric acid, neutralize with caustic, redistill with steam, and give a final caustic wash. Do not sweeten with doctor, as this will destroy color stability.

For domestic fuel oil, depending on the original color of the raw distillate, color stability may be achieved in various ways:

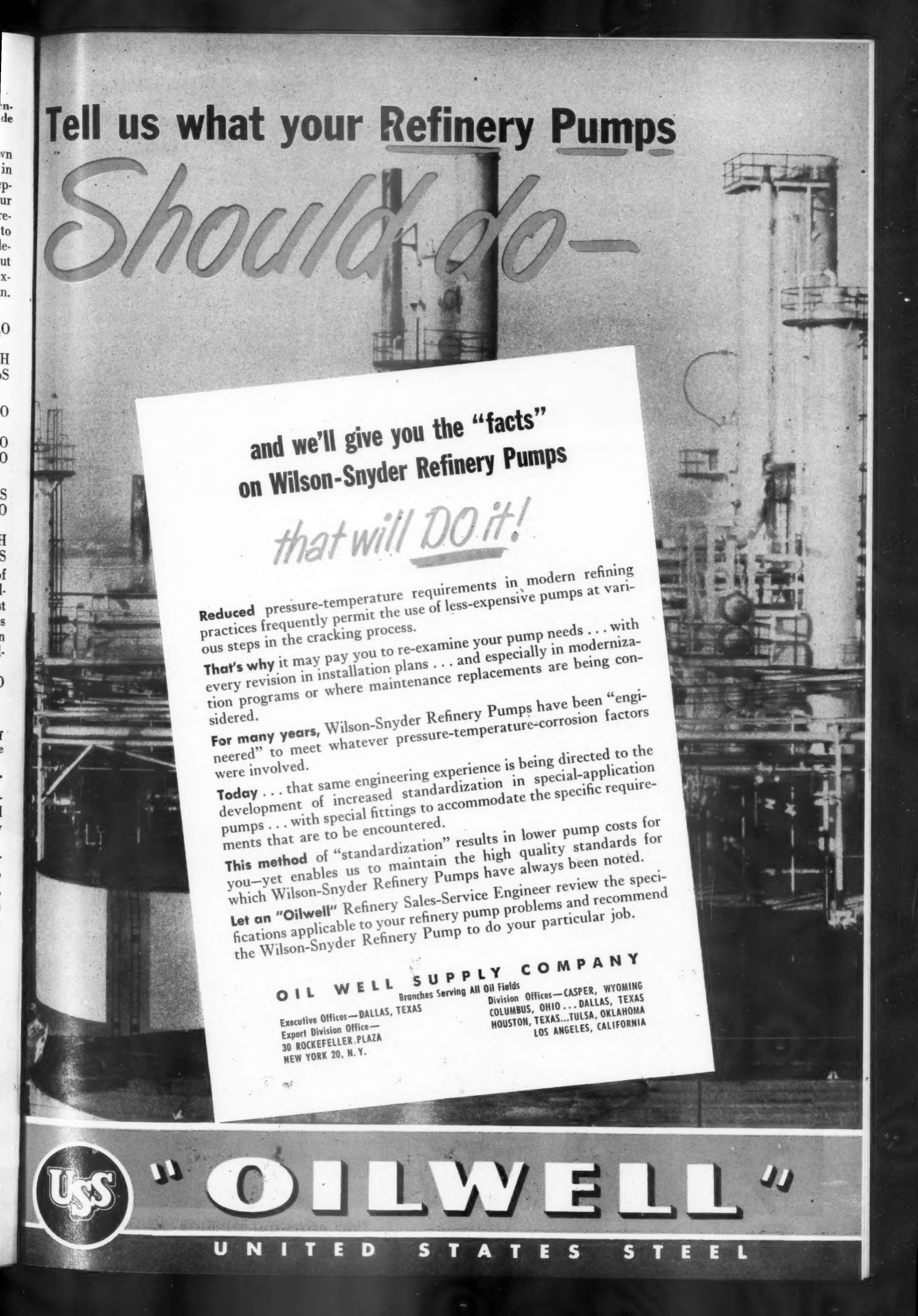
(a) By. adding an alkyl amine (butyl or amyl).

(b) By treating with 60-63-deg Be acid, neutralizing with caustic, and agitating with fine fullers earth.

(c) By filtering through fullers earth and adding an alkyl amine.

(d) By redistillation after acid treating and neutralization.

(e). By other combinations of the above steps.—*C. R. Wagner.*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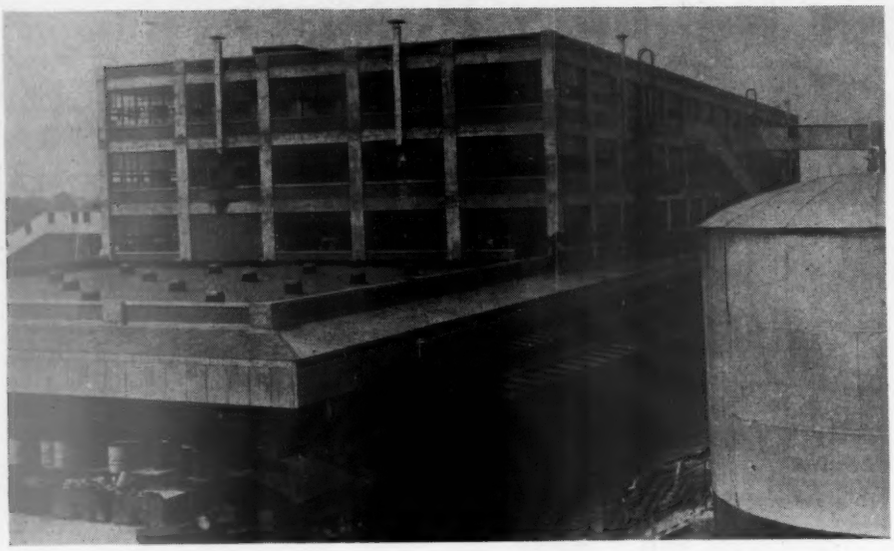


Sinclair's new grease and compounding plant, Houston refinery.

Simplicity and Efficiency Mark Grease Plant Design

ARCH L. FOSTER

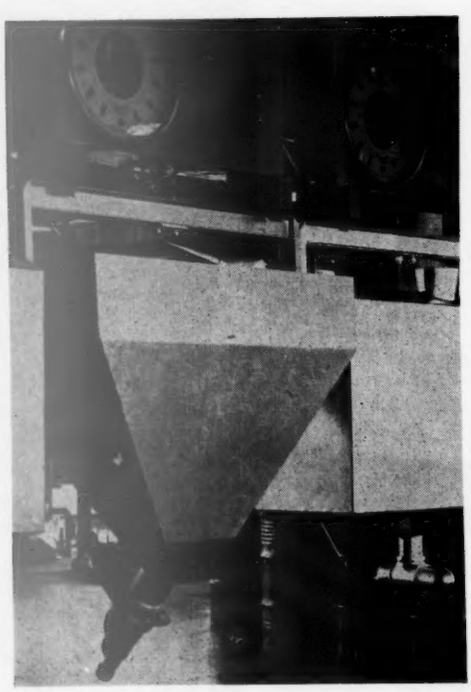
EXCLUSIVE

SINCLAIR Refining Company recently built a modern barrel house and grease plant at its Houston refinery that will supply oil and grease to the southern states, as will as a large portion of the Mid-Continent area. This plant was located at its Houston refinery rather than one of the other refineries because of its distribution advantages, as well as its crude oil transportation and refining facilities. Both paraffinic and naphthenic lubricating oils are refined in this plant starting from the crude.

Built alongside the Houston ship channel, the barrel house and grease plant are housed in a brick and concrete building, consisting of four stories and a basement, which is approximately 420 ft long and 120 ft wide with a full length loading dock on each side. This building is supplemented by a one story drum reconditioning plant on one side and a one story storage building on the other. The latter is approximately 370 ft by 90 ft and is used for accumulating large quantities of filled containers for loading on ships.

The main building is divided so as to segregate the lubricating oil operations from the grease plant. This building is fire proofed structural steel above the first floor and reinforced concrete below that point, showing the best type of present day construction practice. The building walls are brick

Weighing tank to measure components used in making grease soaps, etc.

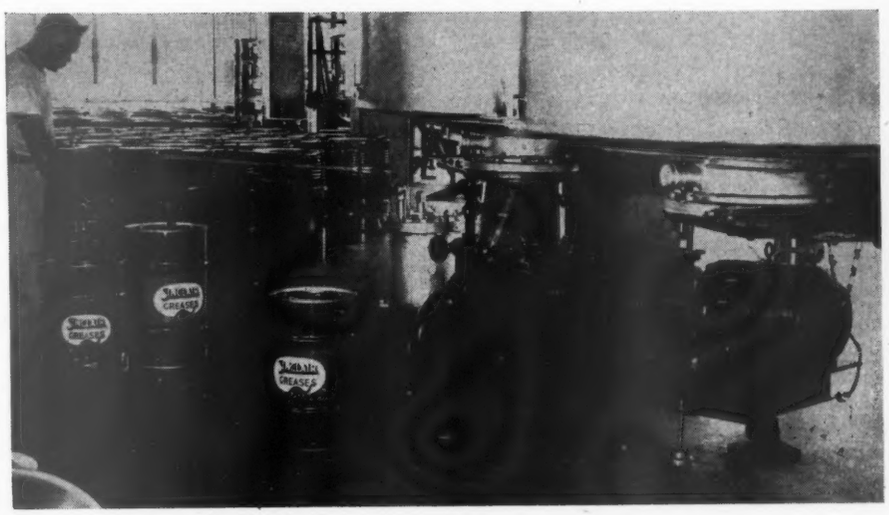


Tops of grease kettles showing also the caustic weight tank.

Main battery of pumps in Sinclair grease and compounding plant, for transfer of all types of oils.

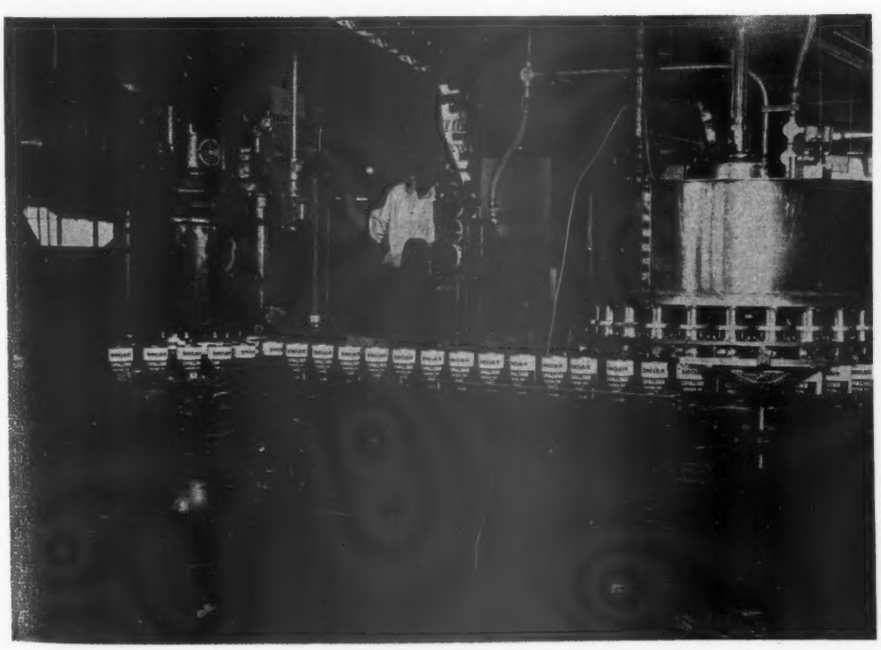
with a maximum amount of windows to provide light and ventilation.

On the fourth floor of the grease plant are located 16 steel storage (working) tanks of about 50 bbl capacity each, also one aluminum tank of the same capacity for fatty acid. Ten grease kettles of about 1700 gal capacity each, one experimental kettle of 120 gal capacity and two pressure soap kettles of 300 gal capacity each are located on the third floor. All are equipped with double action mixing paddles and side scrapers and are powered with two-speed Imperial electric motors through a Link-Belt gear reduction. Each pressure soap kettle is connected to four grease kettles. The kettles are set with the tops only slightly above the third floor and extend down to the second floor filling room. The grease kettles are remotely connected with one recording potentiometer and one indicating selective switch potentiometer on a centrally



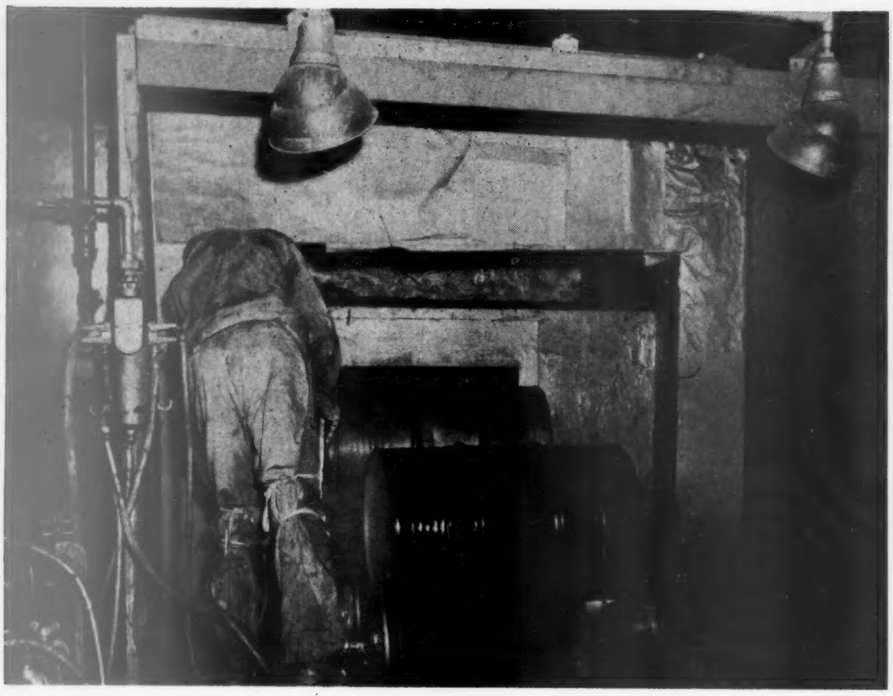
Milling machine assembly, portable, to "work" greases prior to packaging; filter at left middleground.

Continental can-filling machine, geared to fill 300-325 quart cans with motor and other oils per minute.

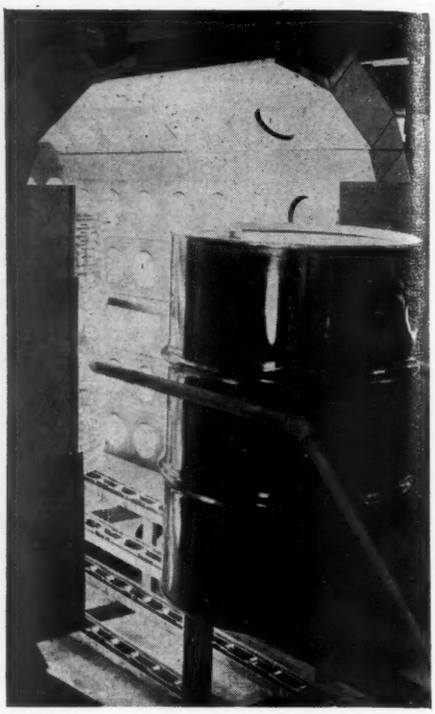


located control panel. Oil is introduced in the kettles by gravity from the working tanks on the fourth floor through meters equipped with pre-determining automatic shut-offs. Compounding ingredients are conveyed to the soap kettles in weigh-tanks that are suspended from scales operating on a complete mono-rail system. The soaps are flashed into the grease kettles by the pressure developed in the soap kettles during the process of its manufacture. Workmen are equipped with protective devices while operating these units, especially for handling liquid caustic. Various soaps are made as required for the numerous greases using aluminum, soda, lime, and other bases along with fatty acids.

Individual gear pumps are suspended from the bottom of the kettles on the second floor, which discharge the greases through Cuno motor-driven



Painting reshaped drums, on revolving table.



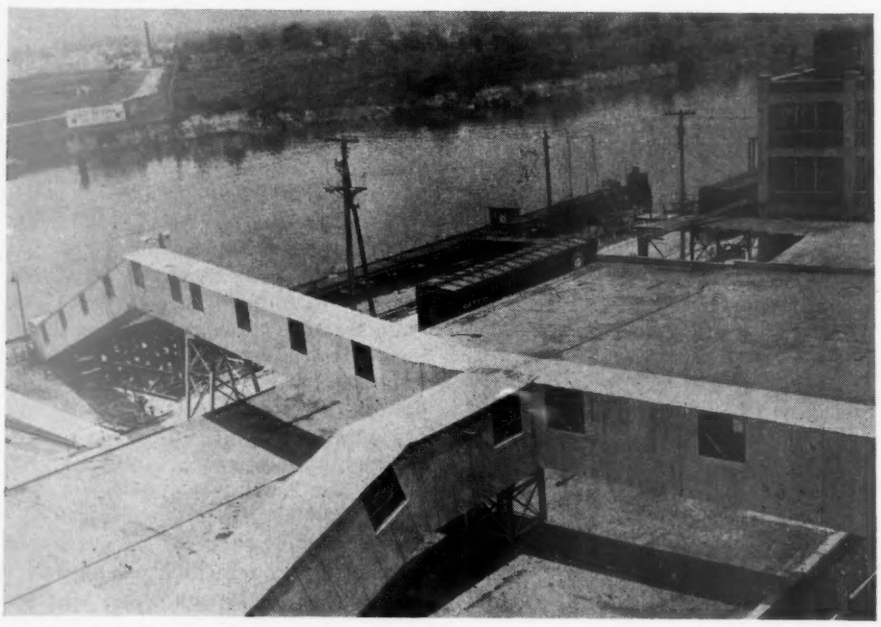
Drums pass between banks of infra-red floodlights to quick-dry paint.

filters to the automatic can filling machines on the same floor, or the drum filling equipment situated on the first floor. Some greases are milled before packaging. These greases are pumped from the kettles into cooling tanks, located on the second floor, and after the grease has cooled for approximately 24 hours, it is forced through a milling machine, of Sinclair's design, with high pressure supplied by Quinby pumps.

The remainder of the main building is devoted to compounding, blending, filling, and handling lubricating oils. The fourth floor of this section of the building is used entirely for the storage of empty cans. Seventy-five storage tanks are located on the third floor from which the finished oils are filled into shipping containers. Each tank is of approximately 100 bbl capacity. Twenty-five hot room tanks (350 bbl capacity) are located on the first floor and are used for storing compounding materials and heavy base oils, including one aluminum tank for storing fatty acid. Eighteen Yale and Towne pumps, set in the basement, are used for pumping materials from the hot room tanks and other base oils from outside storage tanks to the Homogenizer, as well as to the various compounding kettles and grease kettles. These pumps are also used for pumping finished products to the filling tanks on the third floor and are inter-connected by means of an elaborate manifold system. Each line is numbered and marked showing the grade of oil it is used for. Five compounding kettles of approximately 100 bbl capacity and one of approximately 10 bbl capacity are situated on the third floor. These kettles are set with tops slightly above the third floor and extend down to the first floor. Each of these kettles is equipped with heat exchangers through which the oil is circulated by means of a centrifugal pump, located directly beneath the kettle. They are also equipped with lightning mixers.

Additional facilities consist of a Cornell oil compounding and blending Homogenizer having a rated capacity of 75 gpm. This equipment is capable of handling three base oils and

Conveyor system for handling packages; branch extending to left background goes to dockside; right-angled branch carries packages to storage building.



three additives simultaneously, and is equipped with a heater upstream and a cooler down-stream.

Three tamper-proof can filling lines complete with embossing dies, cappers, packers, sealers, and printers are situated on the second floor. Two of these units are one-quart and one is a five-quart filler. One of the one-quart fillers is Continental's high-speed 24-pocket unit having a capacity of 300 to 325 quart cans per minute. The empty cans are delivered to unscramblers on the fourth floor where they are fed to conveyers which take them to the fillers on the second floor. A six-unit Cornell filling machine and two Bowser Xacto fillers are also located on the second floor, which are used for filling various sizes and types of screw cap cans. The packaged oil is conveyed to the shipping warehouse on the first floor, or to the boat-loading warehouse, or directly to the ship-side dock, by means of an overhead conveyer system.

Drum filling units are situated on the first floor, having a total of 14 meters that are supplied by Yale and Towne reversible pumps. Each pump is provided with an oil resistant rubber suction hose equipped with a quick-coupling for changing from one oil line to another. The filled drums are conveyed from the fillers to a down-ender and inspected for leaks, after which, they are up-ended and conveyed over check-scales and then segregated with respect to their destination on a group of storage conveyers. When a complete order has been accumulated the drums on the storage conveyer are released and conveyed to the desired loading point. Loading conveyers extend the full length of the car-loading dock, on both sides of the building. Means have also been provided to convey drums to the boat-loading warehouse, or to the ship-side dock, a short distance beyond this warehouse. A total of 7200 ft of conveyer service is available for handling drums and packages.

The drum reconditioning plant consists of a hydraulic de-denter, two six-unit Portco drum cleaners, an automatic chime straightener and sealer, spray painting equipment and an infra-red drying oven. The painted drums are conveyed to the basement of the main building to be stencilled. Two reciprocating hoists, with automatic feeds, deliver the stencilled drums to the first floor where they are distributed on conveyors to the fillers.

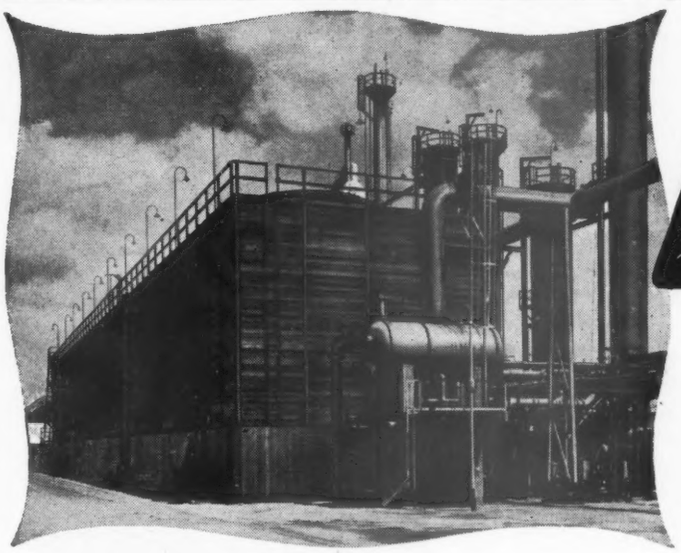
The offices, on the first floor of the main building, are air-conditioned and protected against outside noises by means of acoustical ceilings and double glazing.

Fire Technology

Establishment of a division of fire technology by Harold Vagtborg, president of Southwest Research Institute of Houston and San Antonio, Texas. Pointing out that more than 10,000 people lose their lives annually by fire, that many others suffer needlessly, and that the economic loss in property exceeds $700,000,000, Vagtborg said that the Institute would apply analysis and research to fire control problems.

The layout is relatively simple, but highly practical. The entire setup is handled by a force of approximately 150 men including clerical and office aids, supervisors, etc. Sam H. Vaught, veteran barrel house man, is superintendent of the entire barrel house and grease plant. The grease department is under the direction of A. P. Cannon, long on experience with the company in grease technology, and the compounding department is under the direction of E. W. Blakesley, who has also had many years of experience in his line.

* * *



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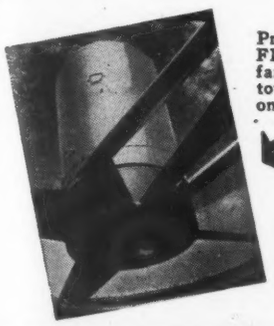

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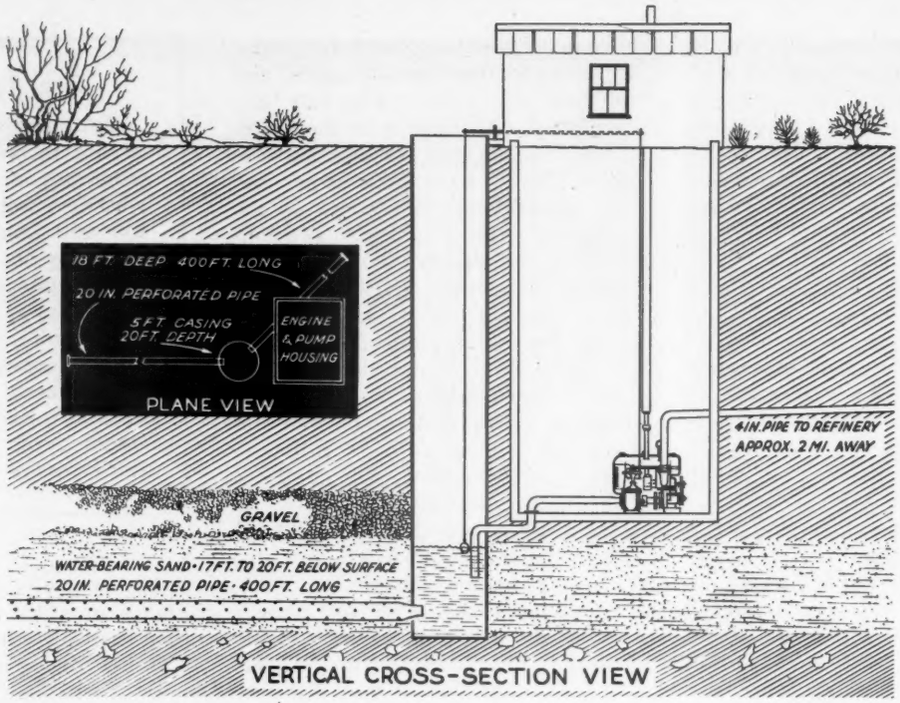

18 FT. DEEP 400 FT. LONG
20 IN. PERFORATED PIPE
5 FT. CASING
20 FT. DEPTH
ENGINE & PUMP HOUSING
PLANE VIEW
4 IN. PIPE TO REFINERY
APPROX. 2 MI. AWAY
GRAVEL
WATER-BEARING SAND · 17 FT. TO 20 FT. BELOW SURFACE
20 IN. PERFORATED PIPE · 400 FT. LONG
VERTICAL CROSS-SECTION VIEW

Pump 2500-Bbl a Day From 3-Ft Water Sand

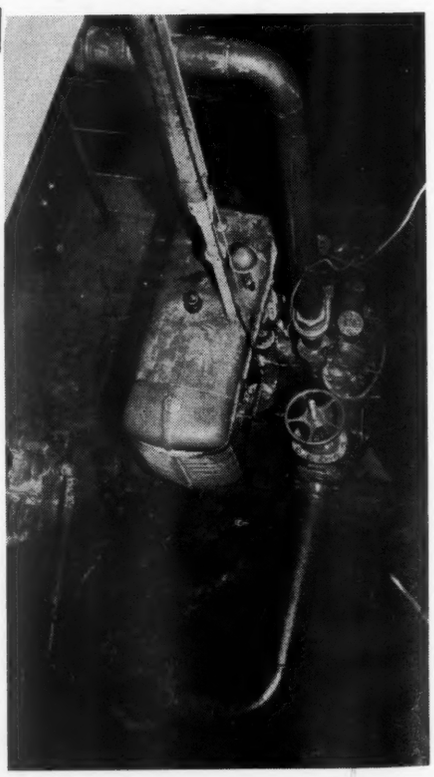
An ingenious method of obtaining a large quantity of water from seeping sand has been developed at the Waggoner Refinery, W. T. Waggoner Estate, near Electra, Texas, where a "horizontal" well has drawn 2500 bbl a day from a three-foot sand formation since 1944.

Superintendent J. O. Walkup designed the unique well that year to meet an emergency. The plant was threatened with closing because the city of Electra was unable to supply enough water to meet its requirements. Another source had to be established quickly. The well was sunk, and water transferred from there to the refinery through two miles of four-inch pipe by an International U-2 engine on a centrifugal pump.

This 79,000-gal-a-day supply, augmenting quantities obtained from the city and from three outdoor tanks, made it possible to continue operations through the last year of the war and to date.

Principal feature of Walkup's method is the use of two 400-ft lengths of 20-in. pipe, imbedded in the water sand 18 ft beneath the surface. Quarter-inch slots in each pipe, staggered around the circumference and down the length, permit water to seep in from the sand.

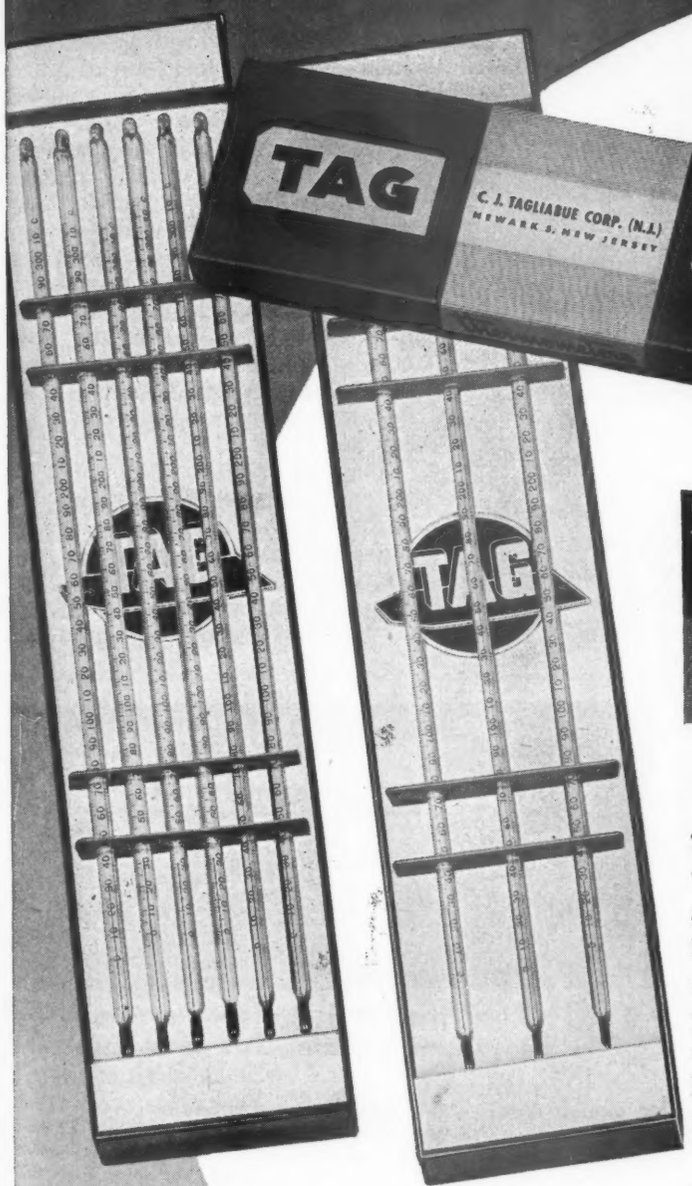
The key to the success of the Waggoner well in draining water quickly from the low-pressure reservoir of seeping sand is the amount of water-gathering surface exposed to the sand. A conventional well shaft would contact the water formation only in a three-foot vertical cross-section, extending around the circumference of the shaft.

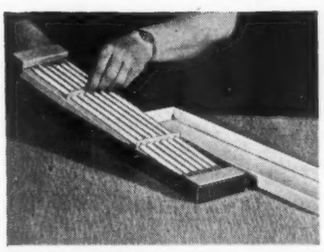


"Payoff station" of the Waggoner well is this shaft beside the casing. The International U-2 engine and Ingersoll-Rand CRV-2 centrifugal pump operated 24 hours a day for more than four years, with no servicing other than normal maintenance.

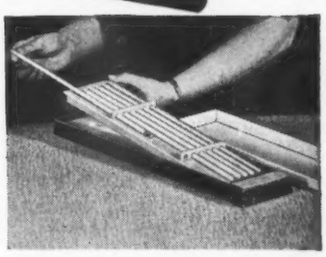
Ahead in packaging, too!

TAG A.S.T.M. and Standard Grade Thermometers





To remove thermometers, simply raise end of box platform.



Thermometers readily slide in or out of spacing retainers.

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Exterior of Waggoner Refinery's unusual well. Foreground, top of casing into which water drains from submerged pipes. Housing in background covers shaft where engine and centrifugal pump are located. Swing arm at back edge of casing is part of the float control system, which regulates speed of pumping in accordance with level of water in casing.

On the other hand, the pipes, stretching along the length of the formation in which they lie, contact a far greater area of water-bearing sand. Consequently, a larger quantity of water seeps into them than would into an ordinary well shaft. Fortunately, the formation at the Waggoner Refinery has the capacity to replenish its water content.

When the pipes were buried, Walk-up covered them with scrap sheet metal, then a two-foot layer of gravel, to guarantee that the slots would not be clogged with dirt.

Water drains from the gathering pipes into a casing 5 ft in diameter and 20 ft deep. It is pumped from there to an open tank at the refinery, where it is used in boiler feed circulating pumps.

A shaft sunk beside the casing houses the U-2 engine and the pump. Operating 24 hours a day, the engine maintains a flow of 50-60 gal per min, under pressures ranging from 60 to 100 lb.

Pumping rate is regulated by a float control in the casing, which automatically slows the engine when the water level is low, and speeds it up when the level rises. Water is lifted vertically approximately 50 ft overall on the trip from casing to tank. * *

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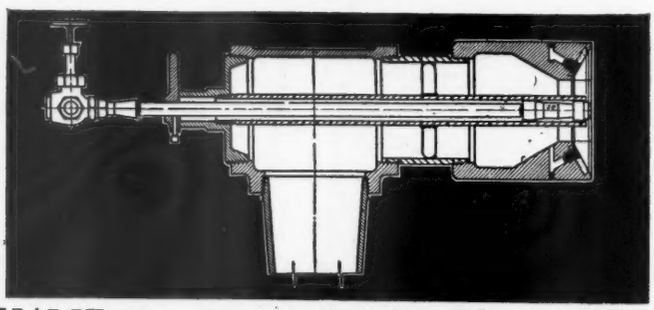

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The Patented "Airocool" Nozzle directs the separate igniter flames against the main volume of the mixture, to insure stable ignition; prevents overheating and burning of the castings, and allows greater turn-down without flame burn-back. Write for supplement 3 to Bulletin 55.

National Airoil Burner Company has specialized in these conversions for more than 15 years. Our numerous successful oil burner installations are applied to sizes 4, 5, 6 and 8 inch inspirating gas burners of all well known makes, whether for boilers, heaters, stills, dryers or kilns. The above illustration includes a combination of our "Airocool" Gas and "S-A-R" Oil Burners. These installations have patented oil burner adapters emphasizing such practicable and exclusive design details as: (1) Ease of withdrawing oil burner without shutting off the gas burner. (2) A self-aligning device to insure the oil burner always being exactly centered with gas burner nozzle outlet. (3) A positioning collar-handle that keeps oil burner tip in correct predetermined position relative to gas nozzle. (4) Although our oil burners may be applied to any standard flame retention nozzle, there is a further definite maintenance advantage in using our specially designed "Airocool" flame stabilization nozzle, which long outlasts any other make of nozzle where gas burners are converted to combined gas and oil burners.

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INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

NEWS

Italian Refinery Doubles Output

The present production of an Italian refinery located at Porto Marghera, near Venice, will be more than doubled under an industrial recovery project, the Economic Cooperation Administration has announced.

Estimated cost of expanding and modernizing the facilities of IROM (Societe Raffinazione Olli Minerali) is the equivalent of $6,400,000 including $2,000,000 in ECA assistance funds. The remainder of the costs will be provided by the company in Italian currency.

In addition to increasing the plant's production from 520,000 tons per year to 1,100,000 tons annually, the project provides for the installation of facilities for the manufacture of lubricating oil.

Holds Fire-Prevention Session

Reduction of accidents within refineries was the subject of the afternoon session of the semi-annual meeting of the National Petroleum Association's department of fire and accident prevention, held October 7, 1949, at the Mt. Vernon, Indiana, refinery of the Indiana Farm Bureau Coop. Assn., Indiana. Norman Begin of Kendall Refining Company, Bradford, Pennsylvania, in his talk on "Safety is Everybody's Business," pointed out that each refinery's compensation insurance rate is tied to the base rate of the entire industry. Reducing your accidents tends to improve the record of all. The program ended with a talk by M. V. Hansen, safety engineer of the U. S. Bureau of Mines at Vincennes, Indiana.

The department's executive committee voted to hold the 25th annual meeting at Cleveland, Ohio, in May, 1950 and to discontinue the fall semi-annual meetings.

Purchases Perco Unit

Evangeline Refining Company has purchased for use in its Jennings, Louisiana refinery a Perco Cycloversion unit engineered and designed by Grebe and Doremus Process Company, Houston and fabricated by Mason Brothers Construction Company.

This single catalyst chamber unit has been designed for a capacity of 400 bbl per stream day. It is unique in that it will be completely fabricated in Houston, and delivered ready for operation except for setting the fractionating tower and connecting the process and utility lines.

Refining Board Members for API Named

Appointed to membership of the General Committee of the Division of Refining, by the president of American Petroleum Institute were:

Paul G. Blazer, board chairman of Ashland Oil and Refining Company, Ashland, Kentucky; **Reid Brazell,** board chairman of Leonard Refineries, Inc., Alma, Michigan; **M. H. Robineau,** president, Frontier Refining Corporation, Cheyenne, Wyoming; **E. L. Shea,** president, Ethyl Corporation, New York; **W. S. Zehrung,** president, National Petroleum Association. All of these appointees are members of the API Board of Directors.

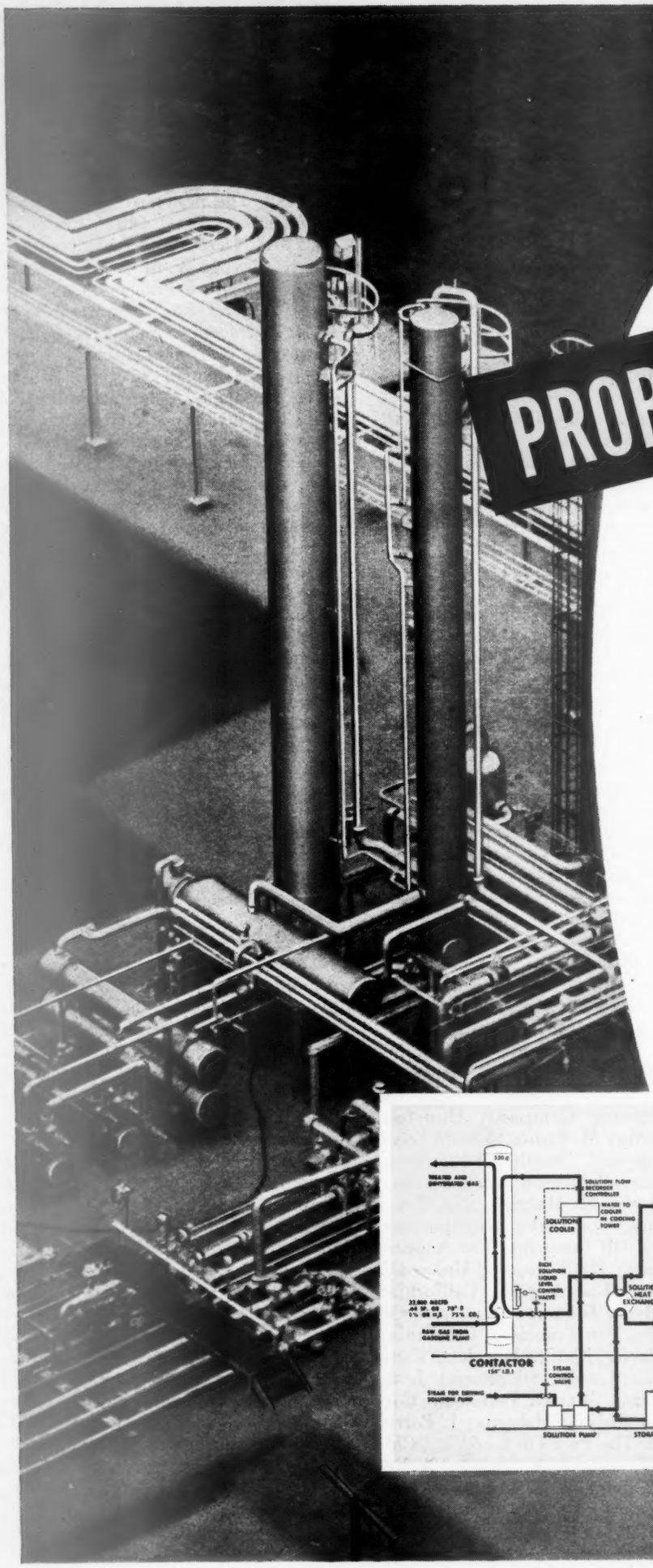
The other 45 members of the General Committee of the Division of Refining were elected in open session of the division in the Grand Ball Room of the Stevens Hotel at 10 a.m., Thursday, November 10, 1949. They are as follows:

W. R. Argyle, Sinclair Refining Company, New York; M. W. Boyer, Esso Standard Oil Company, New York; G. H. Burrus, Anderson Prichard Oil Corporation, Oklahoma City, Oklahoma; H. S. Chase, Tide Water Associated Oil Company, New York; W. J. Carthaus, Deep Rock Oil Corporation, Tulsa, Oklahoma; G. A. Davidson, Standard Oil Company of California, San Francisco, California; C. E. Davis, Shell Oil Company, Inc., New York; D. E. Day, Richfield Oil Corporation, Los Angeles, California; John C. Day, Western Petroleum Refiners Association, Tulsa, Oklahoma; Roy J. Diwoky, Pan-American Southern Corporation, New Orleans, Louisiana; J. H. Dunn, Shamrock Oil and Gas Company, Amarillo, Texas; E. E. Ebner, Quaker State Oil Refining Corporation, Emlenton, Pennsylvania; H. W. Ferguson, Humble Oil and Refining Company, Houston, Texas; Max M. Fisher, Aurora Gasoline Company, Detroit, Michigan; A. P. Frame, Petroleum Advisers, Inc., New York; M. Halpern, The Texas Company, New York; John Hancock, Hancock Oil Company, Los Angeles, California; Basil Hopper, Union Oil Company, Los Angeles, California; H. Y. Hyde, Tidewater Associated Oil Company, San Francisco, California; W. V. Keeler, Phillips Petroleum Company, Bartlesville, Oklahoma; J. A. La Fortune, Warren Petroleum Corporation, Tulsa, Oklahoma; J. Porter Langfitt, The Pure Oil Company, Chicago, Illinois; H. A. Logan, Elk Refining Company, Charleston, West Virginia; W. F. Lowe, Natural Gasoline Association of America, Tulsa, Oklahoma; R. E. Luton, Ohio Oil Company, Findlay, Ohio; P. S. Magruder, General Petroleum Corporation, Los Angeles, California; Maurice Machris, Wilshire Oil Company, Los Angeles, California; E. B. McConnell, The Standard Oil Company (Ohio), Cleveland, Ohio; Frank W. McCurry, Derby Oil Company, Wichita, Kansas; L. W. Moore, Pan-American Petroleum & Transport Company, New York; John W. Newton, Magnolia Petroleum Company, Beaumont, Texas; J. L. Nolan, Farmers Union Central Exchange, St. Paul, Minnesota; Harold G. Osborn, Continental Oil Company, Ponca City, Oklahoma; Max G. Paulus, Standard Oil Co. (Indiana), Chicago, Illinois; J. B. Rogerson, Lion Oil Company, El Dorado, Arkansas; W. F. Stroud, Atlantic Refining Company, Philadelphia, Pennsylvania; T. J. Sullivan, Gulf Oil Corporation, Pittsburgh, Pennsylvania; C. S. Teitsworth, Socony-Vacuum Oil Company, Incorporated, New York; C. H. Thayer, Sun Oil Company, Philadelphia, Pennsylvania; R. L. Tollett, Cosden Petroleum Corporation; Big Spring, Texas; J. W. Vaiden, Skelly Oil Company, Tulsa, Oklahoma; John S. Wertz, Vickers Petroleum Company, Wichita, Kansas; C. R. Williams, Chicago Corporation, Corpus Christi, Texas; L. E. Winkler, Rock Island Refining Corporation, Indianapolis, Indiana; G. E. Wynn, Mid-Continent Petroleum Corporation, Tulsa, Oklahoma.

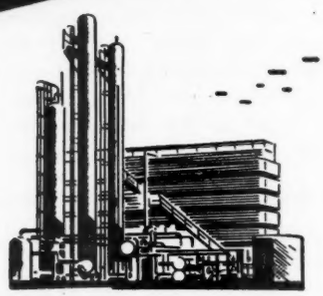
Internships Offered

Opportunities now exist for outstanding students in science and engineering to broaden their undergraduate or graduate training through vacation-time employment and graduate fellowships offered by the National Bureau of Standards. The Bureau has established a work-study program, beginning at the college-sophomore level, for the selection and training of its research scientists and engineers. This program permits the student to alternate periods of full-time study with actual work experience in his chosen field, supplemented by on-the-job training and orientation courses at the Bureau. At the same time it enables the Bureau to select promising students, upon graduation, for permanent appointment to its staff and to provide them with opportunities for professional growth and advancement through further training.

Appointments of this kind provide the Bureau with the services of specialists in many fields who often can bring a fresh approach to a particularly difficult problem.

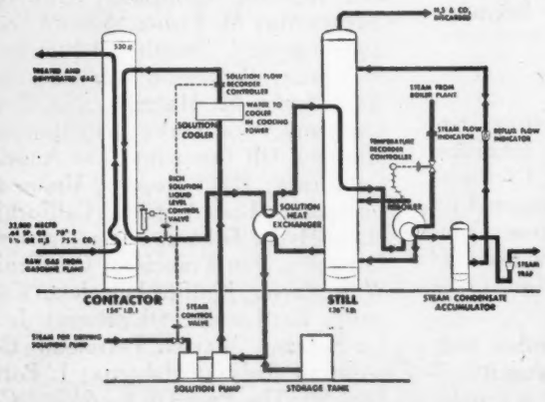


PROBLEM: GUARANTEE T... TO 0.15 GRAIN...



SOLUTION: THE FLUOR GLYCOL-AMINE GAS-TREATING PROCESS

EXAMPLE: LYTLE GASOLINE ABSORPTION PLANT AT COALINGA, CAL.



THE FLUOR GLYCOL-AMINE PROCESS AT WORK IN THE LYTLE GASOLINE ABSORPTION PLANT

The flow diagram shown at left is typical of the many Fluor Glycol-Amine Gas-Treating Processes installed throughout the United States. Patented in 1939 by The Fluor Corporation, Ltd., the Fluor Process is *the original single-stage process* for the *simultaneous* high purity treating and dehydration of gases. Because it is a single-stage process, it reduces outlay and equipment inventory, makes for economy of capital and operating cost. In addition, the Fluor Glycol-Amine Process dehydrates the gas steam during normal hydrogen sulphide removal—makes further drying of gas after treating unnecessary.

URIFY 33,000,000 SCF/D OF SOUR GAS
F HYDROGEN SULPHIDE PER 100 SCF

The Lytle Gasoline Absorption Plant at Coalinga, California, is a story of the Fluor Glycol-Amine Gas-Treating Process at work.

Expansion of natural gas supply through deeper drilling introduced into the Lytle Plant a natural gas so high in hydrogen sulphide content that it was no longer acceptable as commercial sales gas. After processing for gasoline recovery, the discharge gas was analyzed and found to contain 1.25 grains of hydrogen sulphide per 100 SCF and up to three-fourths of 1 mol per cent of carbon dioxide. Even though this gas was sufficiently pure for sale in many areas, in this particular instance requirements for commercial gas were set to *not more than 0.15 grains of hydrogen sulphide per 100 SCF*... a purity requirement so stringent that it would only be attempted by Fluor Gas Processing Engineers using the Fluor Glycol-Amine Gas-Treating Process.

Following study of the requirement by Fluor, a Research Department pilot plant was set to run at gas composition and operating conditions simulating those at the Lytle Plant. Here it was *proved* the Fluor Glycol-Amine Gas-Treating Process could meet—*and exceed by a comfortable operating margin*—the 0.15 grain per 100 SCF requirement efficiently, economically, and on a guaranteed basis.

The plant for the Lytle job was then designed on the findings of the Fluor Research Department. Engineering was set in motion, and a field construction schedule formulated.

The Lytle unit is a "sweet"-running unit paralleling laboratory and pilot plant findings—meeting its guaranteed performance with an adequate margin. This new installation raises the total installed capacity of Fluor Glycol-Amine Gas-Treating Plants to 585,000,000 SCF/D.

Fluor invites owners and operators of gas-producing properties to submit their gas-treating problems for study and recommendation by Fluor's Gas Processing and Research Engineers. Let them study *your* particular problem—the range of purity obtained through use of the Fluor Glycol-Amine Gas-Treating Process is virtually unlimited. It may be the low-cost answer to your gas-treating problem.

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NEWS

Shamrock to Construct Unit

Shamrock Oil and Gas Corporation is constructing at its Sunray, Texas refinery a Perco cycloversion unit designed for a capacity of 1500 bbl per day.

Upon completion early in 1950, the unit will be operated for both gas oil cracking and naphtha reforming. Shamrock has designed the catalyst chamber sections for completely automatic valve control.

Kansas Refinery Completed

MFA Oil Company has almost completed construction at its Chanute, Kansas, refinery of a Perco Cycloversion unit, engineered by Koch Engineering Company, Wichita, Kansas.

The single catalyst chamber unit has a design capacity of 1000 bbl per stream day. Dependent upon the operating conditions, it will catalytically desulfurize or reform straight run and cracked gasolines.

Cit-Con Refinery Opened

With the opening of the new $40,000,000 Cit-Con refinery, one of the most modern lubricating oil plants in the world has begun full operations on a 360-acre tract at Lake Charles, Louisiana.

The plant is owned by Cit-Con Oil Corporation, formed by Cities Service Company and Continental Oil Company for building and operating the refinery. With the sole exception of the Duo-Sol plant, designed and constructed by Max B. Miller Company, all other units of the refinery were designed and constructed by the Lummus Company, New York.

Shell Chemical Opens New Service Laboratory

A new technical service laboratory designed to benefit all industries using petroleum-derived chemicals was opened at Union, New Jersey, by Shell Chemical Corporation. The application of chemicals in surface coatings, particularly lacquers and enamels, in hydraulic brake fluids and antifreezes, will receive special study in the new laboratory. The laboratory is the latest step in a continuing expansion program by Shell Chemical in both the manufacturing and marketing fields.

The new laboratory is under the direction of Donald S. Herr, who previously directed the company's technical service laboratory at Martinez, California.

Deep Rock Plant Staff

A plant manager and seven new department heads have been appointed to Deep Rock Oil Corporation's Cushing, Oklahoma, refinery. The new appointments include: **K. O. Stowell,** plant manager; **J. F. McDonald,** assistant chief engineer; **Quentin Benedict,** supervisor of distillation and treating; **Raymond E. Feasel,** supervisor of cracking; **Robert A. Forsman,** supervisor of maintenance and shops; **Everett W. Hubbard, Jr.,** supervisor of products handling, and **Wilson Bentley,** industrial engineer.

Stowell, formerly superintendent of Bay Petroleum Corporation's refinery at Chalmette, Louisiana, becomes the refinery manager succeeding acting manager **George Waltershausen,** who retired on company pension November 2, but who will serve Deep Rock as a consultant.

McDonald received his BS degree in petroleum engineering in 1941 and MS degree in 1947, both from the University of Tulsa. Benedict, obtained his BS degree in chemical engineering from the University of Cincinnati in 1942, and took two years' extension work at Pennsylvania State College before joining Ashland Oil and Refining. Coming to Deep Rock from an assistant superintendent's position with Rock Island Refining Corp. Feasel, supervisor of cracking, brings nearly a quarter century of oil refining experience with him.

Forsman was graduated from the University of Tulsa in 1942 with a BS degree in petroleum engineering. Hubbard joined Deep Rock a year ago after receiving a degree in industrial engineering from Oklahoma A. & M. College. Bentley fills the newly-created position of industrial engineer, which will include personnel training, plant sanitation, plant safety, and new methods. Bentley received a degree in industrial engineering from from Oklahoma A. & M. in 1939.

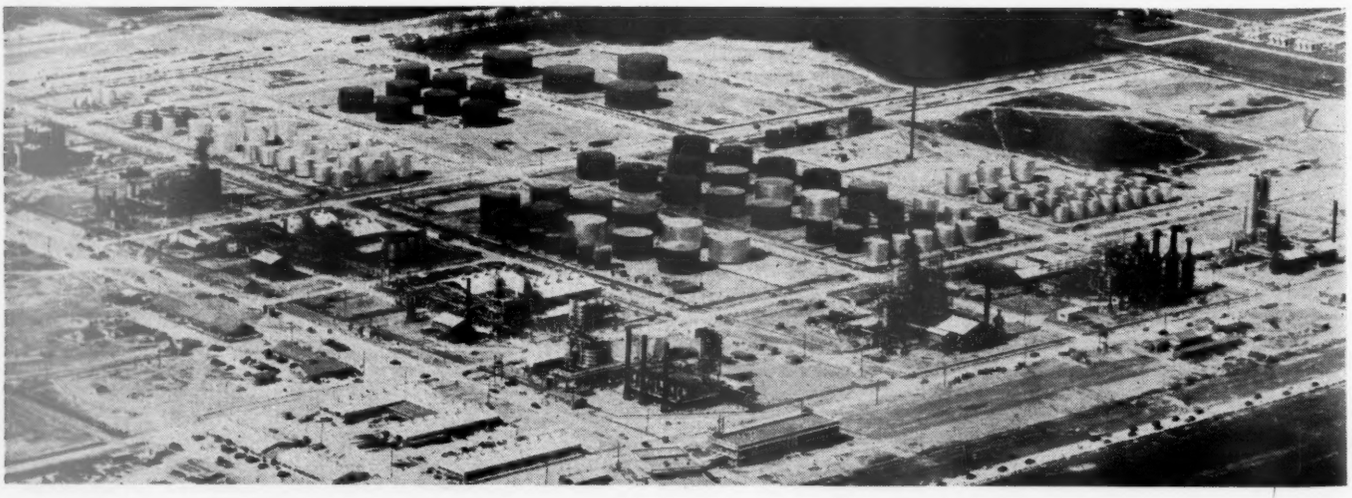
Socony Receives Award

For its "outstanding job in the employment of veterans" the East St. Louis, Illinois, plant of Socony-Vacuum Oil Company, Inc., has been awarded a citation by East St. Louis Post No. 53 of the American Legion. The refinery returned veterans to jobs with pay equal to what they would have had if they had not been in service.

Announces New Publication

A new and complete bibliography of books and published reports on gas turbines, jet propulsion, and rocket power plants has just been published by the National Bureau of Standards and is now available from the Superintendent of Documents, U. S. Government Printing Office, Washington.

This air view shows the L-shaped layout of the processing units at the new Cit-Con refinery, Lake Charles, Louisiana. From right to center foreground can be seen, in order: Vacuum distillation units, solvent refining units, and the steam plant with three smokestacks. Continuing to the left are two MEK dewaxing units, clay contact plant, and wax finishing unit.



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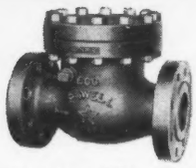

Fig. 6061—Class 600-pound Cast Steel Swing Check Valve.

There are obvious disadvantages in buying flow control equipment from several different sources. Then why get your bronze or iron valves from one place, your steel valves from another, and possibly corrosion-resisting valves from several others, when Powell *makes them all**?

This is an age of specialization; and whereas various manufacturers are emphasizing valves that meet certain flow control requirements, Powell specializes in making valves to meet *all* the demands of every branch of Industry. And there's only one standard of quality at Powell—to make the right valve to suit the service, and to make it the best.

Plants representing every branch of Industry have found that it pays to make Powell—and *only* Powell—responsible for the performance of all their flow control equipment. So why not come to Powell for all *your* valve requirements?

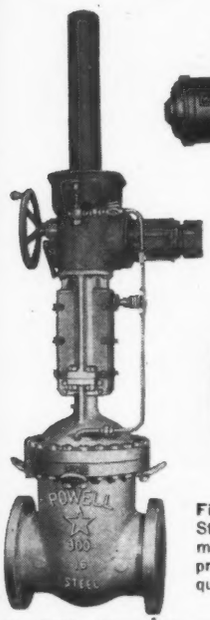

Fig. 3023—Class 300-pound Cast Alloy Steel Gate Valve with automatic steam sealing mechanism. Has explosion proof electric motor operator.

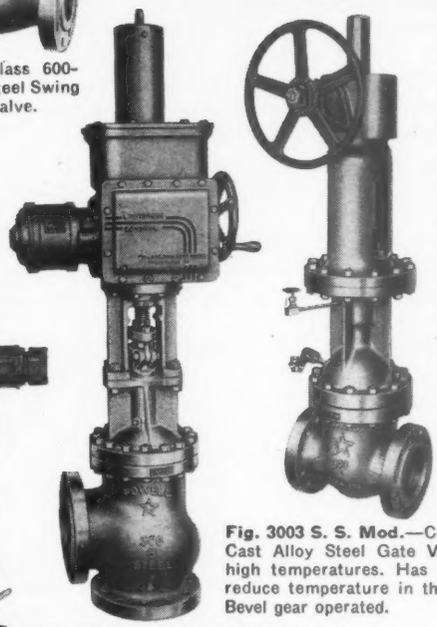

Fig. 3053 — Class 300-pound Cast Steel Angle Valve, equipped with top-mounted, fully enclosed, explosion-proof, electric motor operator for quick, positive opening and closing.

Fig. 3003 S. S. Mod.—Class 300-pound Cast Alloy Steel Gate Valve for ultra-high temperatures. Has cooling fins to reduce temperature in the stuffing box. Bevel gear operated.

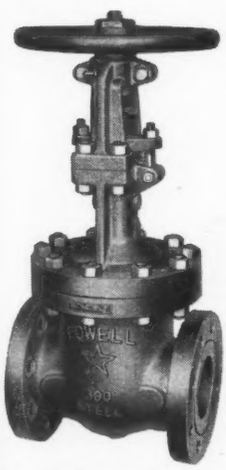

Fig. 3003—Class 300-pound Cast Steel O. S. & Y. Gate Valve.

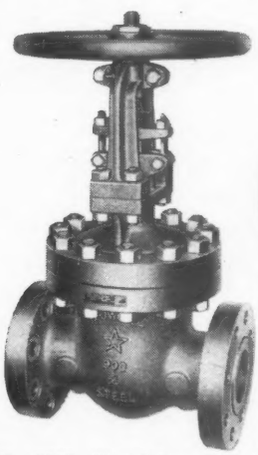

Fig. 9003—Class 900-pound Cast Steel O.S.& Y. Gate Valve.

Fig. 1793—Large 125-pound Iron Body Bronze Mounted O.S.& Y. Gate Valve.

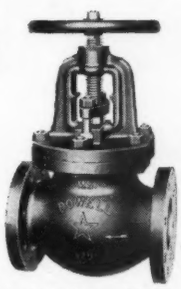

Fig. 241—Large 125-pound Iron Body Bronze Mounted O. S. & Y. Globe Valve.

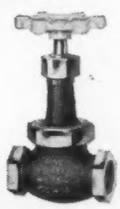

Fig. 8150—Bronze L. P. G. Globe Valve with screwed ends, union bonnet and special composition disc.

Fig. 1708 — 200-pound Bronze Globe Valve with renewable stainless steel seat and regrindable, renewable "Powellium" nickel-bronze disc. ➤

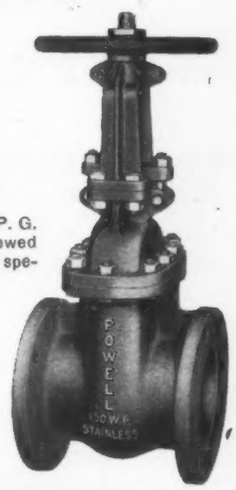

Fig. 2453-G—Large 150-pound Stainless Steel O. S. & Y. Gate Valve. Sizes 5" to 30".

* Powell Valves are made in Bronze, Iron, Steel and a wide selection of Corrosion-Resistant metals and alloys. Valves of every type—Globe, Angle, Gate, Check, Non-return and Flush Bottom Tank Valves—are included in the Complete Powell Line.

Fig. 1314-A — Class 1500-pound Steel Integral Bonnet "Y" Valve. Also made in Globe and Angle patterns.

Fig. 375 — 200 - pound Bronze Gate Valve with renewable "Powellium" nickel-bronze disc.

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We'd like to send you a free sample of the new Fel-Pro C-5 "Hi-Temp" Thread Compound to try on your toughest thread compound problems, including alloy and stainless steels. Then you can see the amazing, money-saving results being obtained by the nation's largest refineries, utilities and process industries. Fel-Pro's exclusive Colloidal-Copper formula keeps metal parts separated, regardless of temperatures. Its neutral action solves the alloy and stainless steel pitting problems. One utility company reports that heater dismantling time has been cut from two days to four hours, by the use of Fel-Pro C-5 "Hi-Temp". Why not see what "Hi-Temp" can do for you... get your free sample and complete data sheet—*write today!*

FELT PRODUCTS MFG. CO.
1535 Carroll Avenue, Chicago 7, Illinois

3337

Standards Division Established in Laboratory

Establishment of a bureau of standards department as a part of its system of 20 research and 17 terminal control laboratories has been announced by The Texas Company, at its central research laboratory in Beacon, New York. This department serves the same general purpose for the Texas Company laboratory system as the U. S. Bureau of Standards at Washington serves for the entire nation. The department standardizes equipment and methods for the entire company laboratory system; it also is responsible for the development of new test methods and improvement of existing methods.

In this function the department tests and checks some 60,000 pieces of testing equipment annually and the excellence of the work done has a direct relationship to the quality and uniformity of production and products. All laboratories are checked regularly to be certain that each follows the same details and routine in carrying out all the numerous tests employed by the company. Part of this system is the sending of identical samples of various materials and products to each laboratory periodically to enable each group to check its methods independently. Some 700 standard test procedures have been adopted to date, and a catalog of approved laboratory apparatus has been assembled.

B-A Refinery Site Chosen

Edmonton area has been chosen by the British-American Oil Company for the site of a modern refinery that, when completed, will employ over 100 men. Actual construction of the refinery will be started early next spring. Surveys are now being conducted on 500 acres of land four miles east of Edmonton. From these 160 acres will be selected to accommodate the refinery and enable warranted expansion.

When in operation, the refinery will have an initial capacity of 2,000,000 bbl yearly, 5500 bbl per day, and will service British American outlets and agricultural accounts.

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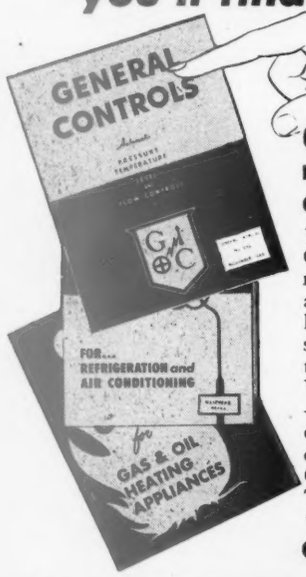
you'll find the answer HERE



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Gulf's Ohio Refineries Complete Expansion

The two Ohio refineries of the Gulf Refining Company, at Toledo and at Cincinnati, are in full operation upon completion of an 18-month program of expansion and modernization that cost in excess of $35,000,000. Sixteen new refining structures, buildings, and plant extensions have been erected at each refinery, as well as additional tankage that increases storage capacity by 50,000,000 gal.

The production capacity of the Toledo refinery has been increased from 1,008,000 to 1,680,000 gal of petroleum products a day. At Cincinnati the daily output can be increased from 1,000,000 to 1,168,000 gal. With operating units modernized throughout, both refineries have been equipped to manufacture higher octane gasolines and to supply motor fuels of improved mileage and performance qualities.

The switches, launching a $35,000,000 expansion of Gulf's Ohio refineries into production, are thrown by R. R. Johnston, general manager of the firm's Toledo division (foreground) and D. E. Hart, superintendent at the Toledo refinery. A similar scene was enacted within a few hours at the company's Cincinnati plant.

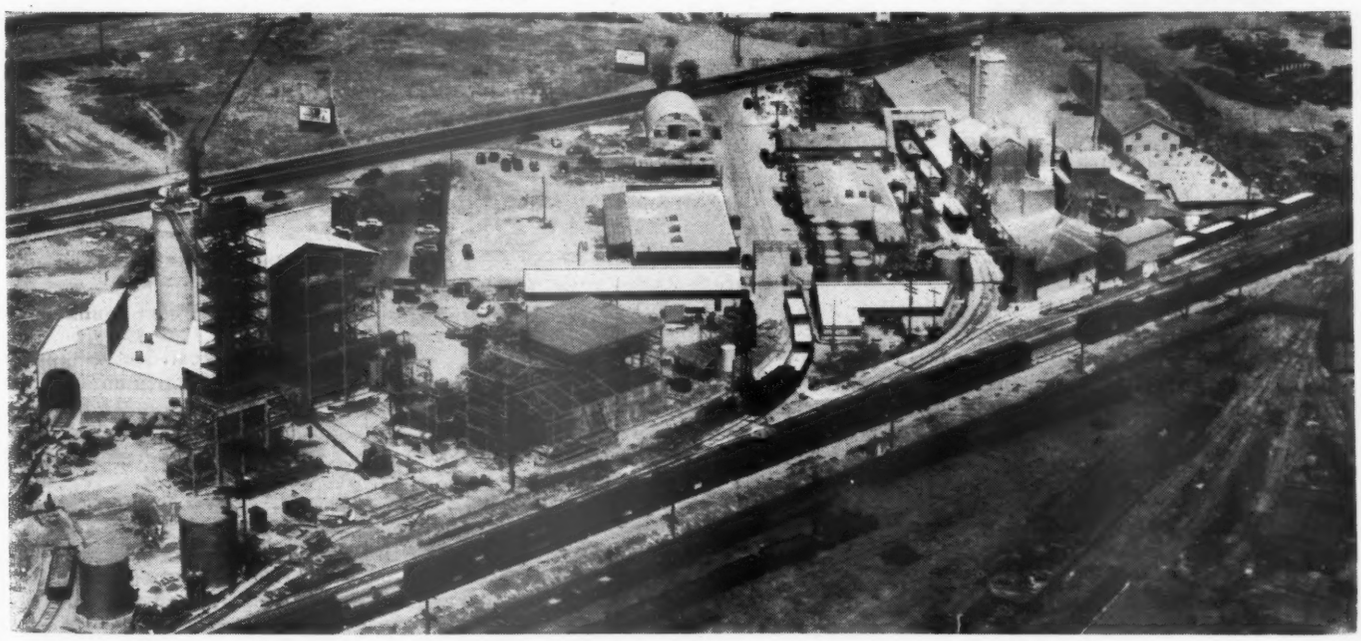
Manufacture Catalysts In Filtrol Plants

Large amounts of cracking and other catalysts, and the filter media employed by the oil refining and chemical industries is manufactured in Filtrol Corporation's California plant, and in a similar plant in Mississippi, which was the subject of an article in a recent issue. In these plants are made both the 'natural' types of cracking and other catalysts, developed from naturally occurring metallic derivative products, and also the synthetic types of catalysts and filter media employed widely in the industry. All cracking catalysts used in practical commercial installations today are composed of metallic products of silicon, aluminum, magnesium, chromium, with sometimes other metallic materials in small amounts as catalyst 'promoters.' Filter media may be made from a wide variety of raw materials, natural or synthetic, for the decolorization and refining of lubricating oils, paraffin waxes and other petroleum fractions.

Fellowship at Texas U.

A graduate fellowship in chemical engineering has been established at the University of Texas, The Texas Company has announced. Purpose is to investigate the relationship between the adsorption of hydrocarbons and their distillation. Results of these studies may have specific applications to distillation problems.

Plant of Filtrol Corporation, Los Angeles, California, which manufactures catalysts, used by the oil industry.



PERSONALS

▸ **Arlie A. O'Kelly,** associate director of the research and development department of the Socony-Vacuum Oil Company, Paulsboro, New Jersey, has been elected chairman of the American Chemical Society's division of petroleum chemistry. He succeeds Wayne E. Kuhn, manager of the technical and research division of The Texas Company, New York.

B. H. Shoemaker of the Standard Oil Company (Indiana), Whiting, Indiana, was named chairman-elect and **C. G. Kirkbride,** laboratory director of the Houdy Process Corporation, Marcus Hook, Pennsylvania, secretary-treasurer. The division named the following area representatives: **Cecil L. Brown,** Standard Oil Development Company, New York; **S. W. Ferris,** Sun Oil Company, Marcus Hook; **A. L. Lyman,** California Research Corporation, Richmond, California; **W. A. McMillan,** The Texas Company, Beacon, New York; **Louis Schmerling,** Universal Oil Products Company, Riverside, Illinois, and **H. M. Smith,** Bureau of Mines, Bartlesville, Oklahoma.

▸ **F. E. Thompson** was appointed safety engineer for Warren Petroleum Corporation. He assumed his new duties November 1, and will direct the corporation's entire safety program.

Thompson was advanced to his new

F. E. Thompson

position with headquarters in Tulsa after several years as superintendent of various plants constructed and operated by Warren. He started as a field man in Brown county, Texas, in 1928 and was advanced through various positions until he was named superintendent of the Fry gasoline plant in Brown County in 1933.

George Ford will succeed Thompson as superintendent at the Madill plant. Ford was assistant superintendent of the Gladewater, Texas, plant at the time it was acquired by Warren, which bought the Hanlon companies.

Bernard H. Shoemaker G. C. Montgomery George A. Lorenz

▸ **George C. Montgomery** has been appointed to the new position of assistant superintendent administrative at Shell Oil Company's Wilmington-Dominguez refinery. In this capacity he will be concerned with all matters relating to personnel, industrial relations, plant protection, safety, public relations, employee activities, and employee training.

George A. Lorenz will replace Montgomery as assistant superintendent-operations. Lorenz joined Shell as a research chemist at the Wood River Refinery after receiving his doctor's degree in chemical engineering from the University of Minnesota.

▸ **Herman E. Ries, Jr.,** of the Sinclair Refining Company Research Laboratories, Harvey, Illinois, has been awarded the $3000 Ipatieff prize in chemistry for 1950, it was announced by the American Chemical Society, which administers the award. Ries, who is 38 years old, was cited for his contributions to the knowledge of the chemical agents known as catalysts, particularly those used in petroleum hydrocarbon conversion.

The prize is given every three years to a scientist under 40 for achievement in the study of catalysis or high pressure.

Ries graduated in 1933 from the University of Chicago, where he was captain of the varsity tennis team. He received the Ph. D. degree in 1936, and joined the Sinclair research staff the same year.

▸ **G. W. McCullough,** vice president and general manager of Phillips Chemical Company, was a guest speaker at the recent fourth annual short course on instrumentation for the process industries, at Texas Agricultural and Mechanical College, College Station.

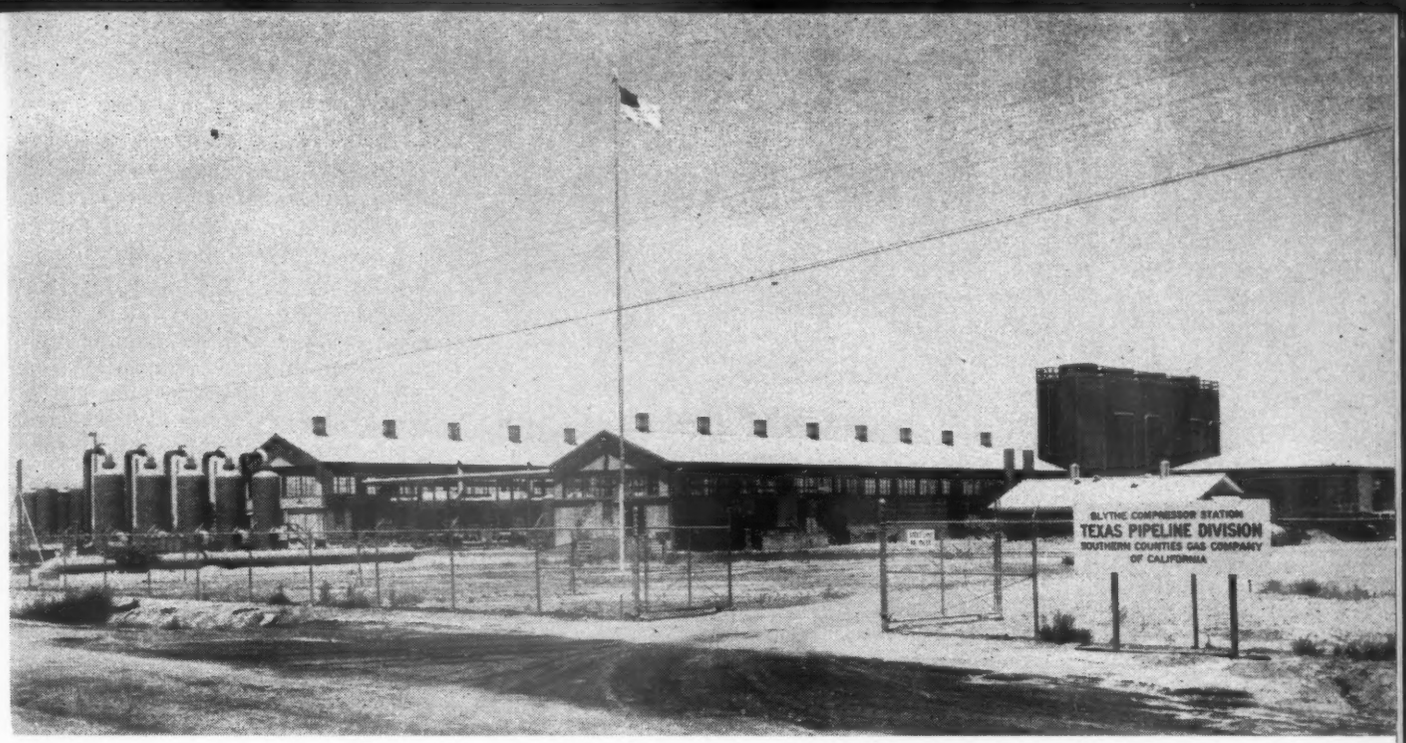
McCullough, the author of several papers on instrumentation and control of process, spoke on "Economics of Instrumentation." He has been with Phillips Petroleum Company and its chemical subsidiary since his graduation in 1925 from Oklahoma A. and M. with a mechanical engineering degree.

▸ **Kenneth E. Kingman** has been appointed Manager of Manufacturing for Union Oil Company of California, W. L. Stewart, Jr., Executive Vice President, announced. **Elmer B. Palmer** was named to fill Kingman's former position as manager of the Los Angeles refinery.

A graduate of the California Institute of Technology, Kingman joined Union Oil in 1929 as a research chemist at the Los Angeles refinery. He became an engineer in the Development Department in 1933 and was named assistant superintendent of operating and treating in 1935. He was transferred to the company's Oleum refinery in 1937 as assistant superintendent of lube treating and became in succession superintendent of operations and superintendent of lube oil, compound and shipping. In 1945, Mr. Kingman was appointed manager of the Wilmington refinery.

Palmer was graduated in chemistry from U.S.C. and in 1920, joined Union Oil as a laboratory inspector at the Los Angeles refinery. In 1930, Mr. Palmer became assistant chemist in the manufacturing department. Following that, he was in succession chief chemist, supervisor of test and control laboratories, general foreman of laboratories, assistant superintendent of operations, superintendent of operations, and early in 1949, was appointed assistant refinery manager.

▸ **Edward F. Everett, Jr.,** has joined the engineering department of the Houdry Process Corporation, as a senior process engineer. He comes to Houdry Corporation from the Marshall-Morman Development Company of New York where he was engaged for several years as a process engineer. Earlier he was process engineer with the M. W. Kellogg Company in New York for a period of 10 years.



General view of the Blythe compressor plant. When prospective additions are completed the pressure of the Biggest Inch gas received at the station will be raised from 480 psi to 807 psi, and an added 100,000,000 cu ft of gas can be handled.

P 625.5

MODERN STATIONS

Blythe to Pump 405,000,000 Cu Ft Gas

RICHARD SNEDDON*

RECENT news reports indicate that the Blythe, California, compressor plant, 230 miles from the Los Angeles terminus of the Biggest Inch gas line, is to be expanded by the addition of two new compressors to the seven already in operation. This added compressor capacity will enable the station to handle approximately 405,000,000 cu ft of gas a day instead of the 305,000,000 cu ft that is its present maximum. The reason for the increase in facilities, which it is hoped will be completed by October 1, is simply that the western requirement of natural gas is rising substantially, partly because of the extended scope of operations, and partly because of the rapid increase in population in the area that the big line serves.

These two reasons may be one and the same thing, but, in any case, a number of extensions of the system have been completed in Southern California since the completion of the trunk line itself. One lateral now supplies the cities of Indio, Palm Springs, and Coachella. Another 75-mile extension supplies the principal cities in the Imperial Valley, hitherto supplied only with bottled gas. On the Los Angeles end of the line, one 30-in. feeder was run into the San Gabriel Valley to supply El Monte, Pasadena, Alhambra, and adjacent population centers. Another 30-in. feeder is now being extended into the southwestern section of the Los Angeles metropolitan area as part of a great loop that will eventually encircle the city. Meantime, a contract was recently let for the construction of an 85-mile line to San Diego. All of which gives some idea of why it became necessary to add extra compressor capacity to the Blythe plant.

Plant Description

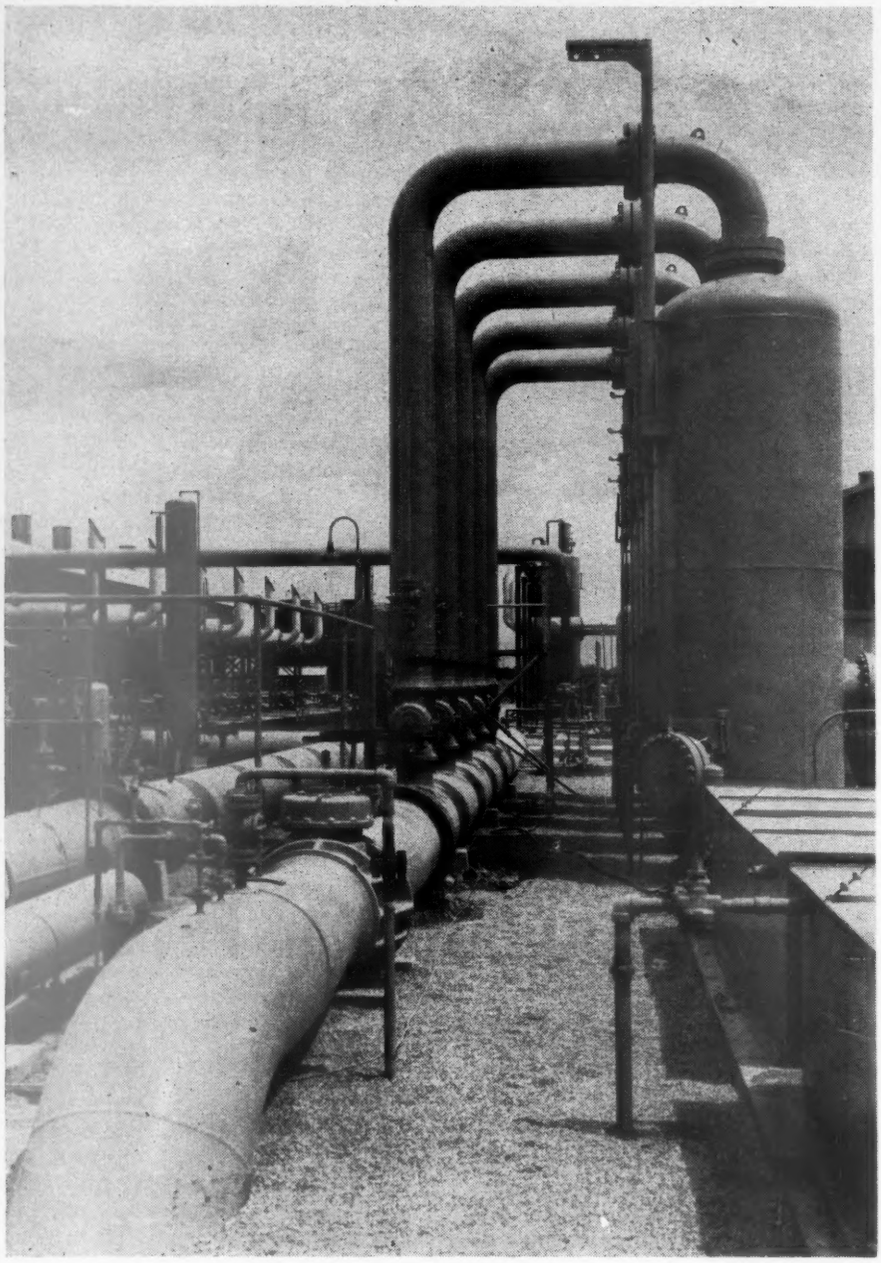
The value of the Biggest Inch to the people of Southern California was thoroughly demonstrated last winter when one of the coldest spells in the history of the state shot the demand for natural gas up beyond anything hitherto experienced. With demands on the two gas companies that own the western facilities amounting to more than a billion cubic feet a day, the supply would have been many million cubic feet short of being able to take care of the peak load had it not been for the Texas gas. As it was, no trouble was experienced in meeting the demand.

The Blythe compressor plant, a joint accomplishment of Southern Counties Gas Company and Southern California Gas Company, was completed according to preliminary plans, which called for seven 1600-hp compressor units, early this year, February 16 to be exact, and it has been handling its full quota from El Paso Natural Gas Company ever since. At this point the gas from the big 30-in. line is received at 480 psi and is boosted to 807 psi, besides being measured, scrubbed, scented, and undergoing several other refining processes before being sent farther along to Santa Fe Springs and the distributing lines.

Situated about 6½ miles west of the Colorado River crossing and 3

EXCLUSIVE

*Pacific Coast editor.



When gas arrives at the Blythe compressor plant it is first put through this battery of scrubbers to remove rust, pipe scale, dust, and any other extraneous material that it may have picked during transport from West Texas and Southeastern New Mexico.

miles west of the town of Blythe in the Palo Verde Valley, the plant occupies a 17-acre site and is entirely self-sufficient. Its facilities include two water wells, an electric power plant, a fire pumphouse, three 2200-bbl water tanks—two for storage of raw water and one for treated water—and adequate tankage to store scrubber oil and other petroleum oils. In addition, of course, there is gas for every need. Employes, it might be mentioned also, are comfortably housed in air-conditioned homes, nine of them, and recreational facilities include a barbecue and a nearby swimming pool. Tasteful landscaping and a plenitude of water make the entire layout distinctly attractive.

The incoming gas is first measured at the Colorado River where it is received from the El Paso Company, then a check measurement is made through five 16-in. orifice meters as it enters the compressor plant. Thence it passes through a series of five gas scrubbers before entering the plant suction header. These scrubbers, 18 ft high and 60 in. in diam, are capable of processing 70,000,000 cu ft a day.

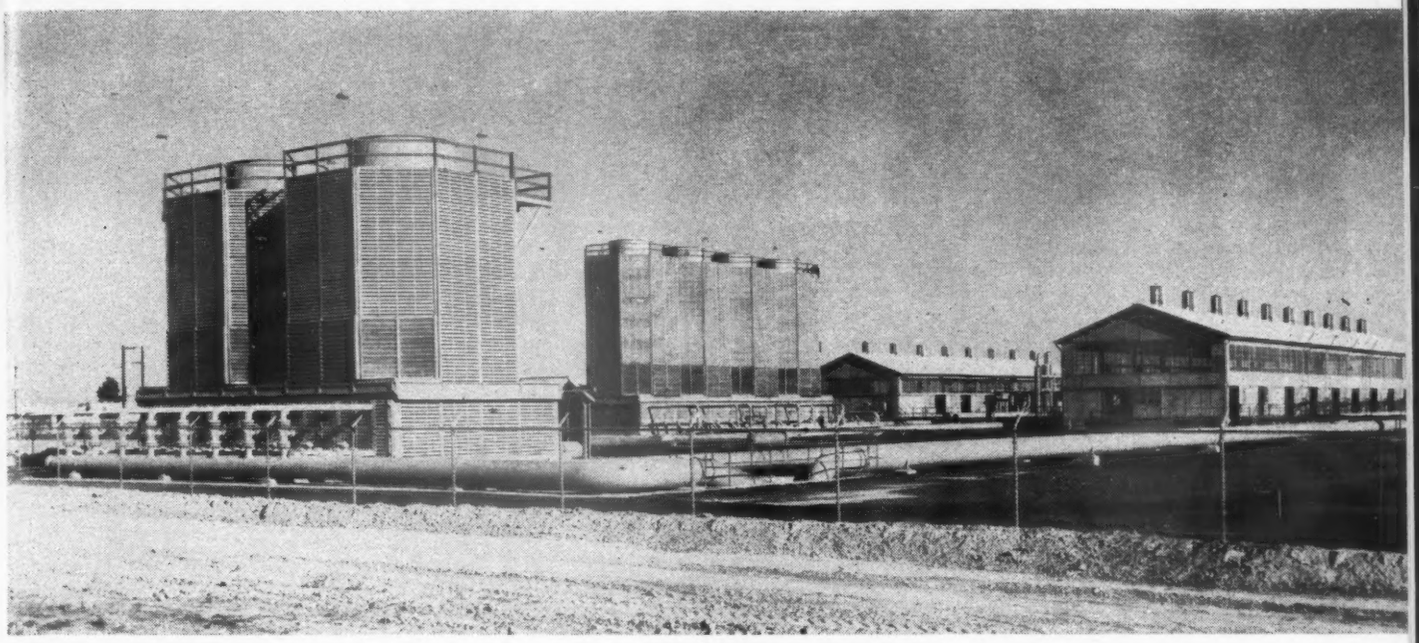
The compressor equipment consists of seven gas-driven units rated at 1600 hp each. Each has eight vertical, 17-in. by 17-in. power cylinders, directly connected to four horizontal, 9½-in. by 17-in. double-acting compressor cylinders. On both suction and discharge side of each unit are pulsation dampners, and the sound of the engine exhaust is in each instance nullified by discharge into well insulated piping and finally into a horizontal silencer.

The process of raising the pressure some 327 psi also has the effect of boosting the temperature about 75 F, which necessitates that it be cooled before delivery into the line for the last stage of its journey across the country. This is accomplished by passing it through a 2-cell cooling tower. Another 4-cell cooling unit is utilized for circulation of engine jacket water to reduce operating temperatures, and to keep lubricating oil cooled to the requisite degree.

Auxiliary Equipment

To the east of the compressor plant is an auxiliary building. In this are housed the plant office and machine shop, a water softening system, auxiliary engines, a refrigeration plant, and three motor generating sets. These latter sets each have an output of 250 kw and consist of direct-connected, gas-engine-driven generators, capable of producing 440-volt, 3-phase, 60-cycle juice sufficient to power all motors and provide adequate lighting for the plant, its adjacent buildings, and residences. The gas engines are rated at 370 hp, and are 11-in. by 13½-in. Starting air is provided by two compressors situated in this same building, one operating on gas and the other electrically driven. They supply instrument air at 150 psi and air at 100 psi for general use. When starting up the plant the gas-fuel compressor is first put into operation. This pumps air at 250 psi into three cylindrical receivers measuring 48 in. in diam, and 12 ft in height. This compressed air is then used to start the engines on the motor generator sets, whence current is derived to run the pumps and the electric-motor-driven compressor.

The two wells aforementioned yield plenty of water for all the needs of the plant as well as for domestic purposes. The high water table existing in the area is an extremely fortunate circumstance, because the atmosphere at times is exceptionally dry and dust storms are not uncommon. Actually the average standing water level is 8 ft, and the wells are 325 ft deep. From



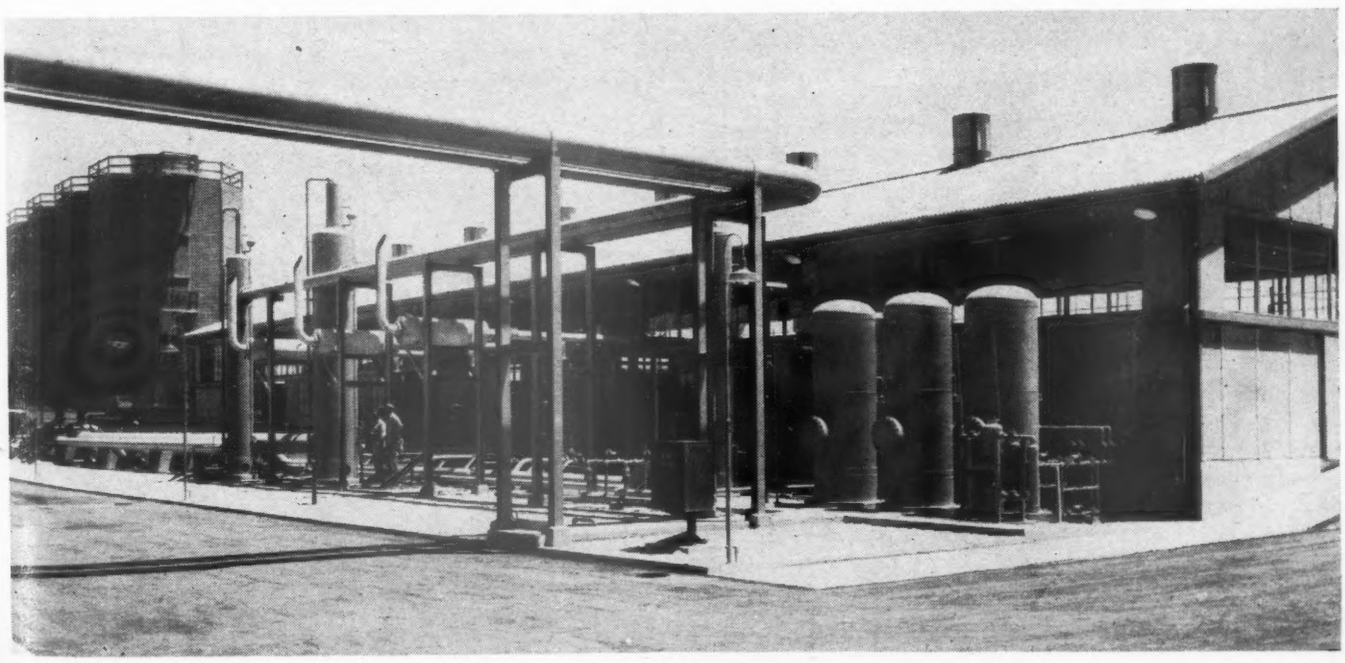
Cooling towers shown in the foreground reduce the temperature of the compressed gas some 30 deg. Those in the background keep engine jacket water and lubricating oil at optimum working temperatures.

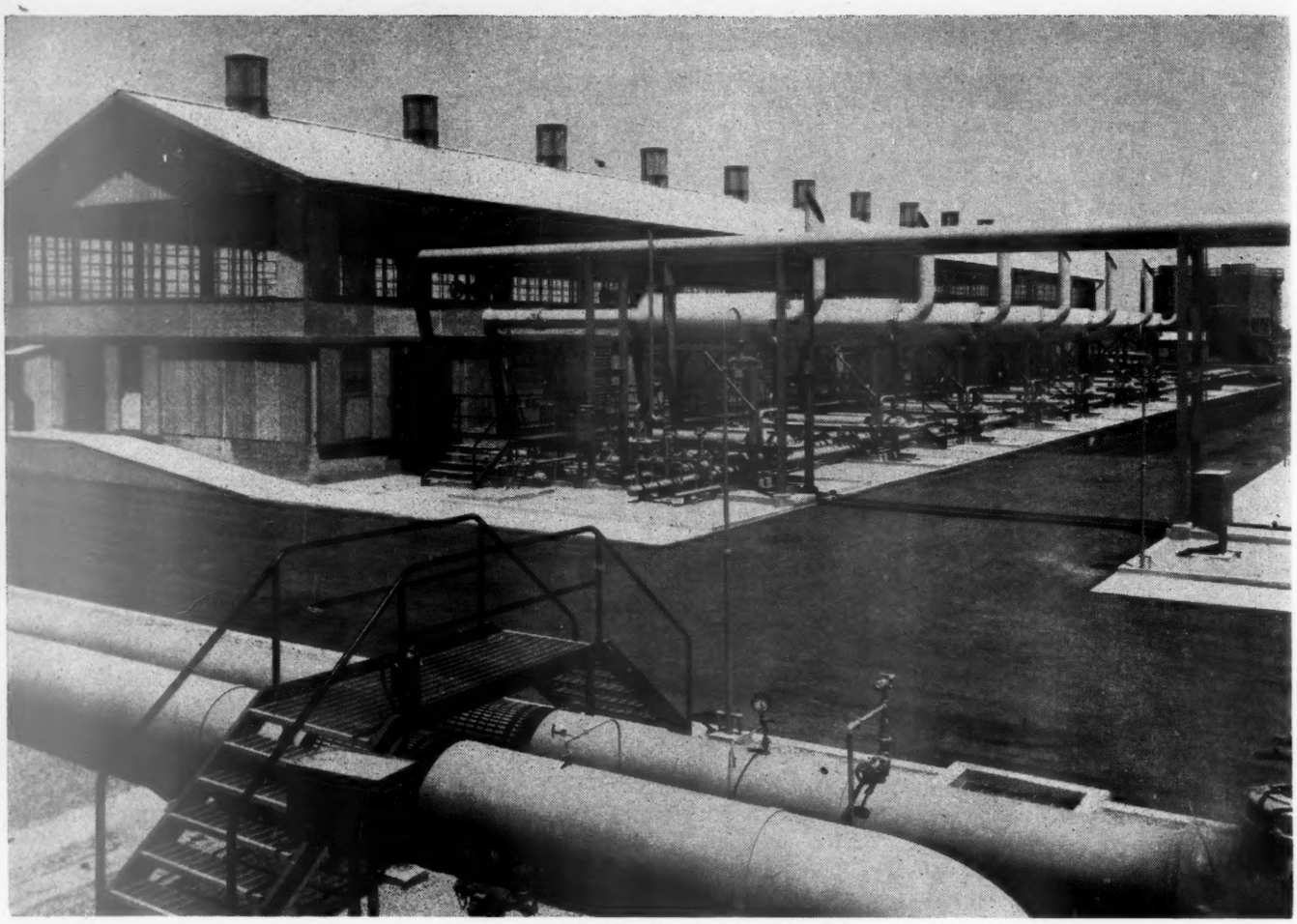
these, two 2-stage turbine pumps deliver approximately 425 gpm each. Important usages in addition to equipment cooling are for fire protection and for air conditioning. The latter consists of a central chilled water system, circulating water at 38 F to the nine residences.

In the interest of safety there are five emergency shut down stations, at any one of which the pressure in the emergency shut down header can be reduced by the opening of a valve. This automatically closes two piston-operated valves, one on the intake and one on the discharge header of the main 30-in. line, where the gas enters and leaves the plant. Simultaneously this opens another piston-operated valve that bleeds down all high-pressure lines except the fuel supply to the three motor generator sets and the fire pump. The system is so constructed that fire measures can still proceed even if the entire plant is shut down. This is rendered possible by a direct line from the trunk to the engine driven fire pump, thus permitting shut down of the generator sets without affecting the gas engine fire pump.

The water cooling system consists, as already indicated, of two induced draft towers. Both of these operate in

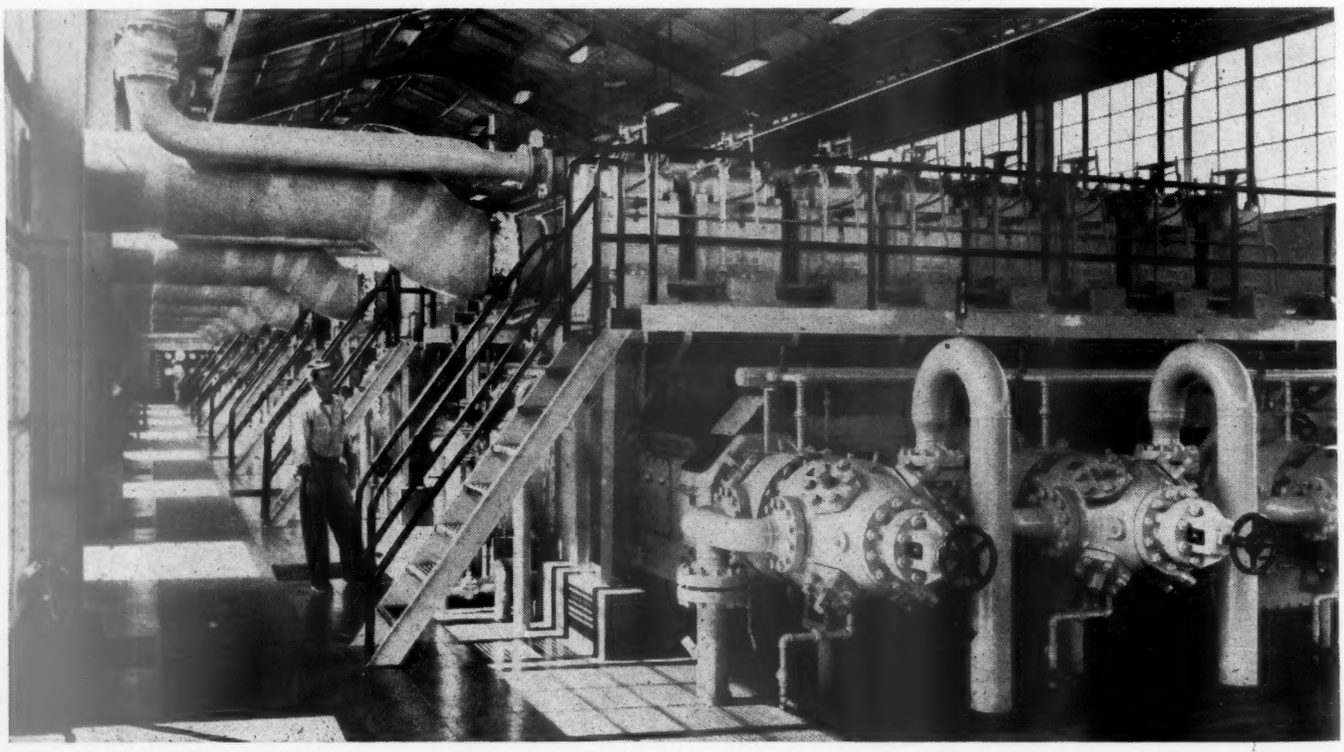
The auxiliary building, just east of the compressor plant proper, houses among other things, electric generating equipment; water-softening system, and central refrigeration plant for cooling homes of employees.





Outside view of the compressor building, which at present contains seven 1600 hp units. Two new heavy-duty engines, rated at 1760 hp each are now being added.

Interior of the compressor building, showing seven compressors already installed and in use. They have been handling 305,000,000 cu ft of gas daily. With contemplated additions it will handle 405,000,000 cu ft per day.



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In application on the Atlantic Seaboard Pipeline job in West Virginia, KAPCO ROCK SHIELD, newly developed protective shield for pipe and pipe coating, has been subjected to strenuous tests and has been found to be more than adequate in giving maximum protection against damage from rock in terrain where dirt padding was impractical.

Easy to apply, KAPCO ROCK SHIELD is a mastic board manufactured in sheets 8' long and in 1/8", 3/16" and 1/4" thicknesses. Sheets are scored lengthwise for ease in forming around the pipe. On pipe diameters of 14" or greater, two sheets are required for complete encirclement of the pipe allowing an overlap on each side. Midwestern has standardized a simple method of securing KAPCO ROCK SHIELD to the pipe by using a high tensile strength fiber strapping (steel strapping also available) and a small ratchet strapping tool.

In a series of penetration tests conducted by engineers in the field, dense limestone rocks—ranging in size from 6-in. x 12-in. x 2.5-in. to 17-in. x 8-in. x 4-in.—were dropped 5 ft. to hit pipe protected by 3/16" ROCK SHIELD, and with both flat and cutting edges striking the Shield. *Even though some of these penetrated the Rock Shield, inspection by electronic detector showed that there were no holidays in the coating.*

ROCK SHIELD eliminates cost of padding the ditch.

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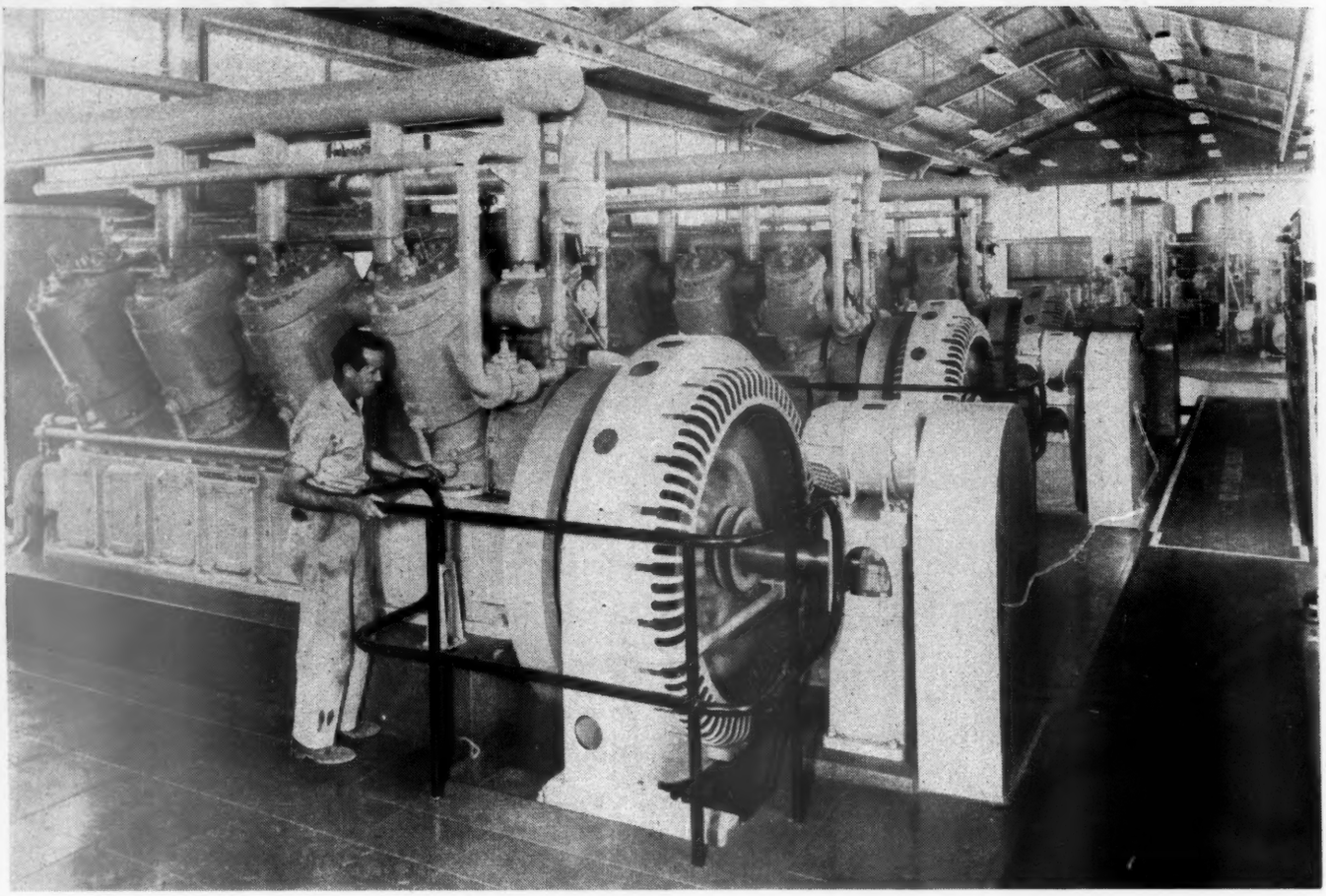


Electric generating equipment consists of three motor generator sets, each with an output of 250 kw. It provides power for all motors, and lighting in both the plant and employee residences.

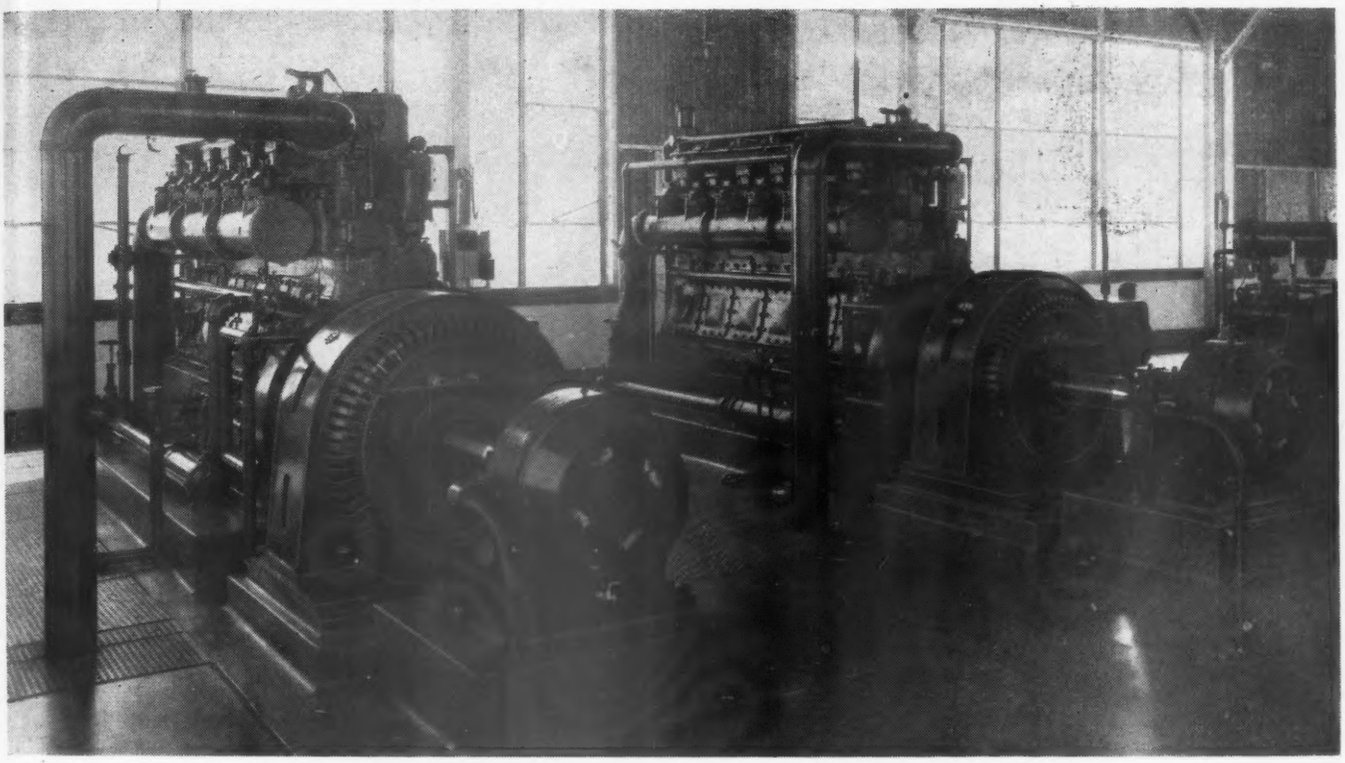
a single stage with 2-pass coils. The 2-cell gas cooling tower is 52 ft long, 31 ft high, and 28 ft wide. Its capacity is 2400 gpm. Water enters this tower at 97 F and leaves at 86 F at 80 F wet bulb. The gas is cooled from 125 to 95 F at 807 psi. The 4-cell jacket water cooling tower is 100 ft long, 47 ft high, and 28 ft wide. It has a capacity of 5000 gpm with 105 F intake temperature and 85 F out at 80 F wet bulb. Jacket water temperatures for the motor generator sets are 160 F out and 150 F in. Each of the six cells in the two cooling towers is equipped with a 2-speed motor so that they can be operated at high speed in summer and low speed in winter.

As the plant is situated some 230 miles from Los Angeles it may be imagined that transportation of machinery and equipment to the plant site presented some ticklish transportation problems. The 60-ton compressor engines were shipped to Blythe in railroad gondolas, and then carried the three miles to the plant site by lowbed trailer and house moving dollies. On arrival, the installation of the heavy engines on the fine desert sand also posed some difficulties. Because of the high water table, foundations were poured in one slab 22 in. thick, heavily reinforced, over specially prepared decomposed granite subsoil, the latter being carefully compacted to give a sound base for the engines.

Indicative of the problems that had to be surmounted on this job was the fact that due to the scarcity of proper ingredients in the desert, it was necessary to transport sand and rock from the San Gabriel wash near Los Angeles—a full 220 miles away. Despite all the difficulties that were encountered, however, the plant was finally completed in good time and is now operating with high efficiency. The soil in the vicinity of the plant is highly corrosive, so it was decided to lay all piping above ground. This permits faster detection of leaks, and quicker remedial treatment when and if leaks do develop. Altogether, in view of the importance of natural gas to modern industrial and domestic expansion, it is comforting to note that the Blythe compressor plant is developing an experience that will be of inestimable value in the economic future of Southern California. * * *

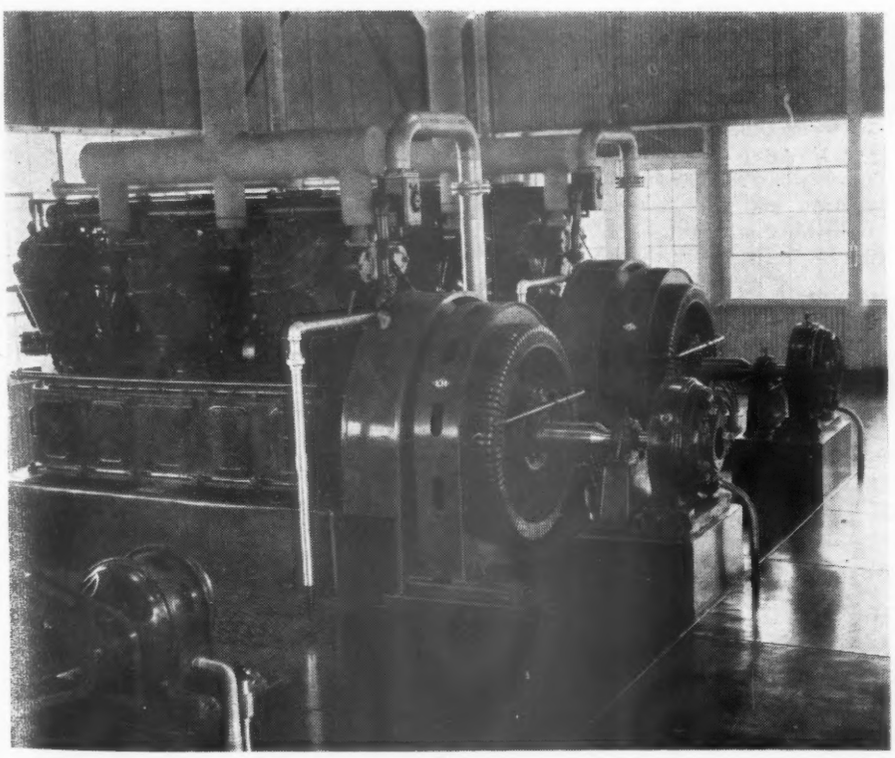
Gigantic Gas System Has 370,000 Miles Pipe

More than 375,000 miles of pipe comprise the gathering, transmission and distribution systems needed to serve the 22,690,000 customers of the gas industry. In the natural gas branch of the industry alone, more than 251,000 miles of pipe lines were in operation at the end of 1948. Today's natural gas pipeline system exceeds the railroad mileage in the nation by 17,000 miles and exceeds the oil pipelines by more than 100,000. An additional 14,700 miles of natural gas pipeline had been authorized by the Federal Power Commission at the end of 1948.



Two 175-kva, 600-rpm Electric Machinery generators with direct connected exciters driven by Worthington gas engines at Hugoton, Kansas, station of Panhandle Eastern.

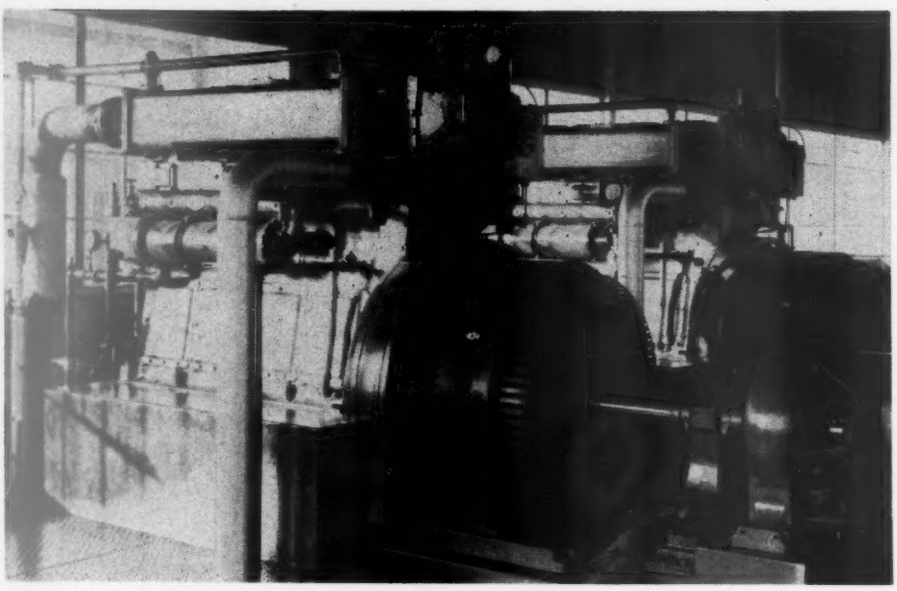
Generated Electric Power for Auxiliaries



Two 250-kva 400-rpm 208/120-volt Electric Machinery generators driven by Ingersoll-Rand gas engines at the Tuscola station of Panhandle Eastern Pipe Line Company.

GENERATOR sets are installed in many of the stations of Panhandle Eastern Pipe Line Company to supply auxiliary electric power. These sets consist of engine-type a-c generators, with direct connected exciters, driven by gas engines. Each set is provided with a suitable generator control panel with individual voltage regulators. Some of the considerations and factors in the selection of capacity and voltage are given in this article.

The primary and largest use of generated power is for pumping water used in the cooling of the engine compressor units. Other uses include air compressors, water wells, pumps circulating water over gas coils for cooling the gas, lights for the station and employes' houses, motors on heating



Two 156-kva, 400-rpm, 208/120-volt Electric Machinery generators with direct connected exciters driven by Cooper-Bessemer gas engines at Greensburg, Kansas, compressor station of Panhandle Eastern.

units and other small equipment, including the FM radio set.

The power requirements vary with the installed horsepower in the compressor stations. The least installed capacity is 250 kw. The largest is 1000 kw, at which station there is a gasoline plant with a large motor load. A typical main line station has 625 kw installed generator capacity, consisting of three units of 125 kw each and one unit of 250 kw. The small generators were installed when the company was small and it was thought that they would be large enough for the needs. When it became necessary to add more generating capacity, the load had increased to the point where another 125-kw unit would not be sufficient. The larger capacity generator was decided on rather than two small units. for economic reasons in addition to electrical.

The growth of the stations brought increasing demands on the cooling water. After studies had been made, some of the pumps were replaced with motors of double the horsepower rating and others were increased from 25 hp to 60 hp. The size of these new motors was one of the prime factors in determining the size of the new generators. The starting current of the large motors can be carried much easier by the larger capacity generators.

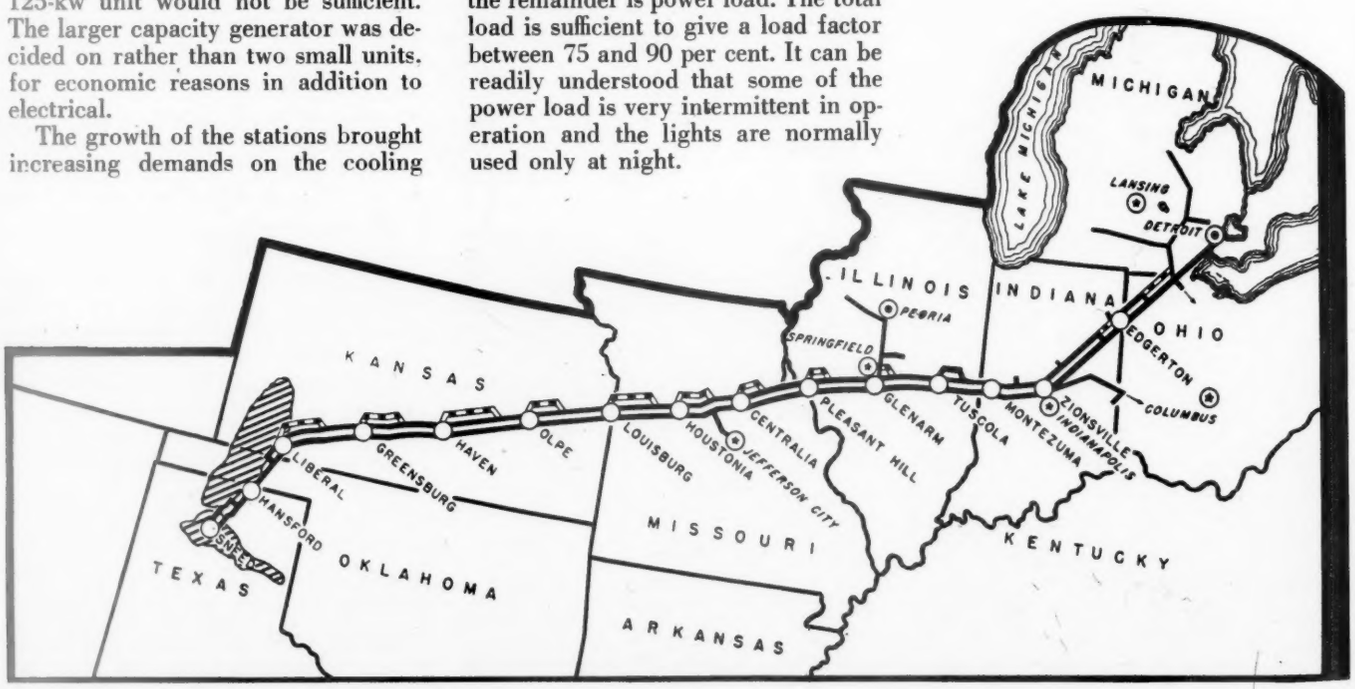
The electrical load on the main line stations is large enough to require the operation of the large generator and two small generators most of the time. This leaves one small generator as a standby unit. The lighting of the stations requires in excess of 60 kw and the remainder is power load. The total load is sufficient to give a load factor between 75 and 90 per cent. It can be readily understood that some of the power load is very intermittent in operation and the lights are normally used only at night.

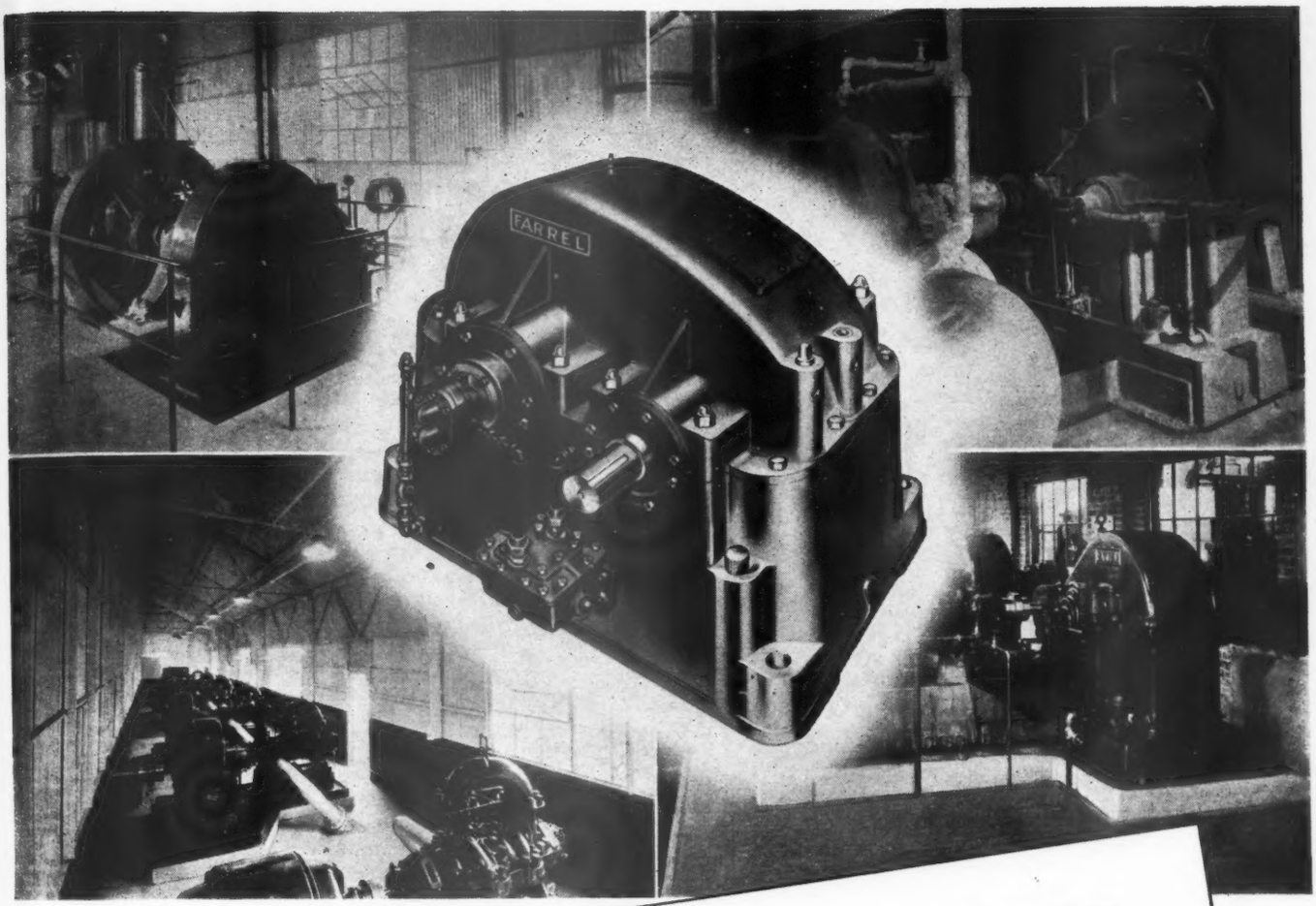
About two-thirds of the stations generate at 120/208 volts and the remainder at 480 volts. The 120/208 voltage is satisfactory for power and lights both without transformers, provided the motors are not situated too far from the source. Even when installed close to the source of power the cable supplying some of the newer motors is very large and starting equipment is large in proportion. At these stations, transformers are used to supply 440 volts to most of the motors situated outside the auxiliary building. In recent years all new stations have had 480-volt generators installed in them with the lighting supplied through transformers.

All generators have individual voltage regulators and provide satisfactory regulation. When the larger motors are started, there are momentary voltage swings of 15 per cent. These do not cause any trouble and, on a system such as this, are unavoidable.

The power distribution is from a power panel at the main switchboard. Individual motor circuits take off with circuit breaker protection. The motor starter with overload protection is usually placed close to the particular piece of equipment.

Maintenance electricians make periodic checks on all electrical equipment. This includes brushes on generator and exciter, contacts and oil in generator breakers, contacts on safety switches, contacts on motor starters, and various smaller items. This is in addition to special maintenance, such as repairs due to equipment failure, or correcting conditions that could lead to equipment breakdown. * * *





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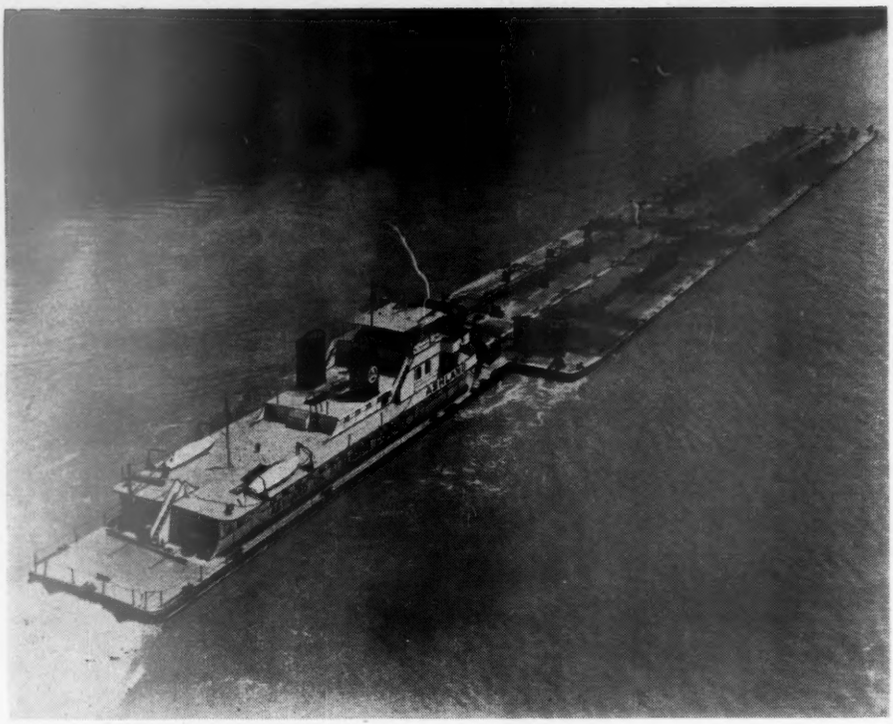

Shown here is the river towboat Ashland, one of the most powerful towboats on the Mississippi system, which has just been rebuilt.

New Engines Bring River Towboat Up-to-Date

That old equipment can be quickly brought up to date was amply demonstrated recently when the Dravo Corporation of Pittsburgh installed in the Ashland Oil and Refining Company's river towboat, *Ashland*, two new 16-cylinder, 2-cycle General Motors Model 16-278A diesel engines. Each is directly connected to an airflex clutch-reverse-reduction gear and rated at 1440 bhp at 720 rpm. New shafting and shaft bearing were also installed.

The new engines, built by Cleveland Diesel Engine Division of General Motors, produce twice the horsepower of the engines they replaced and yet are approximately the same size and only half the weight.

A new stern section was required but by fabricating it in advance nearly two month's time was saved. Also installed were Kort nozzles, a new rudder, steering gear, and propellers.

The pair of Kort nozzles constructed around the *Ashland's* propellers are the result of a development carried on by Dravo. The nozzle is a steel rim that surrounds the propeller and obtains additional thrust by controlling the velocity of the stream of water passing through it.

Built into the hull, these nozzles produce maximum pushing power without increasing the propeller load and, consequently, without requiring increased power. They also assure highest efficiency in handling.

For the first actual test, the *Ashland* was hooked into a fleet of ten coal barges, arranged five abreast and two long to give ultimate water resistance. Then four barges of gravel were added, making 14 loaded barges in all.

Not only did the *Ashland* move them downstream at 6.9 mph, and upstream at 5.08 mph, but did so with an amazingly smooth and quiet characteristic virtually free of all vibration, according to those aboard.

The gauge on the dynamometer barge, which was pushed directly in front of the *Ashland*, showed a thrust of 60,000 lb when underway at 5.08 mph. Dock trials, with the vessel moored at the bank, had previously shown a thrust of 88,000 lb at 700 rpm, and 105,000 lb at 750 rpm.

At one point during the trial, the *Ashland* easily turned the tow completely around and, with a minimum of maneuvering, was quickly on its way again. In previous dynamometer tests, at the same point in the river and with similar sized tows, it had been necessary to "jackknife" the tow into sections in order to head back upstream, but the *Ashland* turned its tow within its own length, saving about two hours in maneuvering.

In order to provide steering power for its tow of barges and itself, the rebuilt towboat has two large rudders behind the propellers for use when going ahead, and four flanking rudders forward of the propellers to receive the stream of water from them when backing.

Ordinarily, in order to replace a damaged rudder on a Kort-nozzle-equipped vessel, it is necessary to go to drydock. A new method of rudder installation in the *Ashland*, however, permits removing and replacing of rudders without hauling the boat out of the water.

A magnetic pilot, designed to hold the boat on a straight course, also is a part of her new equipment. If either the towboat or tow is moved from the course by wind or current, this pilot makes necessary adjustments to bring it back into line.

The Ashland Oil and Refining Company operates a fleet of seven modern towboats for bringing crude oil up the Mississippi and Ohio Rivers by barges, loaded at points in Louisiana, Illinois, Indiana, and western Kentucky, to its refinery, and distributing the finished products throughout the Ohio Valley.

It also has its own fleet of petroleum barges, and is now building one of the world's largest fleets of semi-integrated barges, which will be 975 ft long, three barges in width, and five in length. It will be handled by the rebuilt *Ashland*, now one of the most powerful towboats on the Mississippi system. Towboat and tow will have an overall length of 1126 ft, as compared with liner *Queen Mary's* length of 1020 ft.

With petroleum products already constituting one of the principal classifications of freight moved on the nation's inland waterways, this new tow marks a major advance in the size and efficiency of such cargo movement on the Ohio and Mississippi Rivers.

Three of the first integrated tows on the rivers were built by Ashland Oil prior to the war and are still in service. Though much smaller than the tow now under construction, the efficiency of their operation influenced the design for the new tow. The earlier integrated tows comprised three barges, each 195 ft long by 35 ft wide, connecting into a single unit 585 ft long.

* * *

Winter Supply Problems of Transporters*

S. B. IRELAN†

THE supply problems of natural gas transporters stem from a great many sources, and are generally common to all companies.

The demand of the public for natural gas as a fuel creates these supply problems. Before analyzing them, it would perhaps be well to first consider just what the ultimate consumer wants in the way of service and what his requirements for natural gas are.

I believe that the consumers want unlimited and unrestricted natural gas service and, in my opinion, nothing short of this type of service will satisfy them permanently. The public and the state regulatory bodies look to the transporters of natural gas to supply this kind of service. This is especially true in those consuming areas that are adjacent to the present proved fields and where natural gas has been served over past periods. The consumers, generally, do not understand the necessity for the restriction or limitation of the use of natural gas for any of their fuel purposes and they are not cognizant of the reason why unlimited and unrestricted use is not always available and possible under all circumstances. The extremely low comparative cost of gas as a fuel augments and emphasizes the significance of this situation.

It is our belief that the public has but little understanding of the effect of the seasonal demand for space heating on the cost of service, and the difficulties of supply. When it gets cold, they want the heat that natural gas as a fuel gives, and in plentiful quantities. The public and the state regulatory bodies do not think that the suppliers have any right to attempt to control and dictate the type of natural gas service that they are to enjoy. In those areas that now have natural gas and are adjacent to natural gas fields, the consumers can't understand why there should be any limitation or restriction on their use, when natural gas is being transported to markets in the East and North, and new lines are being announced almost weekly.

Bringing natural gas to new markets on a limited basis at first will result, no doubt, in eventually creating a demand for unlimited, unrestricted domestic use for cooking and space heating purposes. Facing the situation of greatly increased withdrawals, the known reserves will be called upon not only to supply the full unrestricted requirements of present markets, but greatly enlarged markets from the further extension of pipe line facilities. The main problem of the transporter will be to supply these requirements of unlimited and unrestricted service and to meet the demands arising from this type of service.

As a result of this upsurge, created by the demand on the part of the consumer for that type of unlimited service, the transporter faces, as never before, a supply and transportation problem that is greatly enlarged and made much more difficult from all angles. Nothing to compare with it has ever before been experienced in this industry.

The time now seems propitious to give consideration to some of the changes in the supply and transportation problems that are being thrust on this industry. It would also be well to contemplate what the effect of these changes will be on costs and rates, and what new factors the regulatory bodies will have to recognize in order to keep the industry financially sound and growing.

Equating supply and transmission capacity to increased demands is a matter of continuous consideration in this business. In no other industry is there the need to so carefully balance market supply and demand as there is in the natural gas business. It takes planning and provision for additional capacity well in advance of actual need to maintain continuous and adequate service.

In the past, we have not been too much worried over the fact that when a cubic foot of natural gas was consumed it had to be replaced with another cubic foot in order to assure continuing service over the years. Even now, new natural gas reserves are being discovered at a rate in excess of materially increased annual withdrawals.

However, a survey of the situation as to future supply would seem to point to the problem becoming more difficult on account of more competition and increased withdrawals in shorter periods from the presently proved fields. The depletion of these proved fields will require the extension of pipe lines over long distances and to different geographical locations to new fields in order to maintain the supply.

Growth in Demand

The "give-away" price of natural gas as a fuel, compared to its competitors "coal and oil," has caused such a widespread growth in the demand for this refined fuel for space heating, both domestic and commercial, that we in the natural gas business are now engaged in a mad scramble to provide more reserves and more pipe line capacity to satisfy this growth. This price situation has been the primary cause for the building and projection of many pipe lines to new territories from the present proved areas.

This growth in demand has materially changed some of the supply and transportation problems, particularly of those companies experiencing a marked increase in the percentage of space heating saturation.

Natural gas has for many years been known to be the ideal fuel due to its cost, cleanliness, efficiency, and ease of use. Its acceptance under previously competitive rates, particularly for domestic uses, gradually increased over a long period due to improved dependability of service, increased availability, refinements in utilization equipment, and protection afforded by safety devices.

Under the Natural Gas Act, the ultimate sales price of natural gas to consumers, particularly domestic consumers, has currently been reduced or kept far below its real and comparative worth. In almost all sections of the country price comparisons show that natural gas as a fuel is considerably cheaper for most types of service. As a result, the natural gas industry is today faced with an unprecedented increase in demand. Thus far, it has not been possible for the natural gas industry, as a whole, to keep pace with

*Delivered before Independent Natural Gas Association of America, Dallas, Texas, October 31, 1949.

†President, Cities Service Gas Company.

this extreme rate of increase due to the shortage of steel and other necessary materials, plus the time consumed for physical construction of new facilities.

What are the characteristics of this new demand and what can be done to adequately and properly serve it? It appears that by far the greatest part of the new demand is for space heating. Space heating is a winter-time load. Its requirements for peak days and peak hours are a multiple of several times its average daily winter use, and many times its average daily annual use. Increasing the amount of this type of business lowers the system load factor. Obviously, its effect becomes increasingly more serious as the saturation of space heating customers approaches 100 per cent.

Distribution of Demand

The southern sections of the country generally have mild winters, with infrequent low temperature periods of short duration and are, therefore, not confronted with serious load factor problems. The northern sections of the country generally have extended winter seasons, which creates more favorable space heating load factors. The central section of the country, where winter extends only for four or five months, and where temperature fluctuations are extreme, faces the most difficult situation in maintaining a reasonably high system load factor.

Recently published figures indicate generally that current domestic space heating saturation served by natural gas is well above 50 per cent (in most cases approaching 100 per cent) in the southern states, and far below 50 per cent in the northern states. This is to be expected, not only from the more proximate location of gas supply to the southern states, but aso due to the milder winters.

The greatest unsatisfied demand for natural gas for space heating is in the central, northern, and northeastern states. The saturation there is expected to climb at a rapid rate so long as additional reserve supplies and transmission capacity can be made available. Existing pipe lines and those under construction are currently proposing such increases in capacity. How many more new lines or how much more capacity will be provided to serve the new demand depend largely upon the availability and life of the natural gas reserves now discovered and to be discovered. It is generally recognized that the presently known and potential gas reserves of the nation will support only a part of the total fuel market of the country.

We think that it is an obligation of the natural gas industry, first, to assure adequate service for its existing markets, and then to provide further market expansion only to the extent that this new service can be assured over a long period of years. In our opinion, regulatory commissions must recognize and share this obligation. Beyond this, consideration must be given to the load factor of the pipe lines and its bearing on the natural gas sales rates as compared to effective sales rates of alternate fuels. The degree to which load factor can reduce without imperilling the economic safety of a pipe line will depend mainly on the rate at which sufficient gas can be sold in competition with alternate fuels.

It is estimated that the load factor for space heating will vary from 15 to 30 per cent over the country. Because every pipe line must be operated at a reasonably high load factor, those serving a large volume of space heating gas are confronted with the problem of offsetting peak day requirements in some manner. This problem of meeting the peak day demands, arising mainly from the connection of space heating, is one of the major and most difficult problems of the transporter.

Meeting Peak Demand

The gas industry has extensively utilized many devices to meet this peak day demand. The curtailment of interruptible industrial load is common and effective.

Underground storage is utilized in those market sections where depleted gas reservoirs are available and supply substantial percentages of peak day requirements. Both high and low pressure tank or pipe storage are used.

These serve the dual purposes of making gas available for space heating peaks in the winter time and providing an outlet for excess summer time capacity, thus improving the load factor.

Underground storage, in my opinion, as a method of providing peak day gas is much to be preferred over interruptible industrial sales. Interruptible industrial gas must of necessity be sold at relatively low rates and represents a substantial drain on the natural gas reserves. Although such sales are essential in the economics of natural gas transportation, they should be minimized in favor of storage to the maximum extent possible.

Presently utilized peak shaving devices include the use of manufactured gas, propane-air mixtures, and catalytic processes. A new and important peak shaving device has been developed and has been in use for the last year or two. The device is a burner that is capable of burning gas alone, or burning oil with a small amount of natural gas. In operation, the burner uses natural gas during periods when heating requirements are normal. It converts from gas to oil automatically when the temperature drops to a predetermined degree. Experience so far has shown that such equipment, properly utilized, can be made very effective toward the solution of gas space heating peak day problems.

If one or more peak shaving devices do not provide adequate service to all space heating and other non-interruptible consumers on peak days, and if it is uneconomical to construct additional transmission capacity, then there are only two alternatives left—one, limit the connection of new gas space heating; or, two, increase the rates for space heating to comparable costs with other fuels in order to shift a part of the increasing demand to such other fuels.

A large number of gas transporters selling to distributors, or other pipe lines, limit by contract or price penalty the maximum quantity of gas that may be purchased in a given space of time. Although such an arrangement is of some protection to the transporter, the basic problem of characteristics of the demand and adequacy of service are not thereby determined or solved.

During the war, the War Production Board imposed a limitation in given sections of the country on the connection of new gas loads. Subsequently other governmental authorities have imposed restrictions on the connection of certain types of customers or gas loads. Some of these restrictions have since been lifted, but many are still in effect and, undoubtedly, will continue in effect until such time as adequate facilities are available. Practically all lines extending from the middlewest and southwest to the northern and northeastern markets are operating under allocation orders, and even new facilities providing tremendous additional capacity are under allocation orders.

If no limitation on the connection of new space heating customers or load is imposed, and if allocation of available capacity is not made, then in that event transporters are faced with the attachment of an increasing amount of low load factor business and rate adjustments will become necessary as the transmission capacity is increased to meet resulting peaks. Space heating customers would ultimately be forced to bear the resultant increased cost of insufficiently utilized transmission facilities. The end result may be that gas rates for this type of service might rise to the point where

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the demand for space heating would be limited by the economies of substitute fuels.

It is generally conceded that all this sudden growth in demand has been chiefly due, as before mentioned, to the "give-away" price resulting principally from the adoption of the original cost rate base formulas now in effect.

Willard J. Graham, of the School of Business of the University of Chicago, had this to say of this theory as early as the year 1934, and I quote:

"It can be demonstrated rather conclusively that the use of the original cost basis may have serious results from a broad social and economic point of view."

Original Cost Rate

We think that it is appropriate at this point to review what some of the effects to date have been, due to the application of the original cost rate base formulas as applied and adopted by the regulatory bodies, specifically on exploration, production, and gathering of natural gas. Developments to date seem to indicate that the strict application of the formula of original cost, depreciated on a straight line basis, to production and gathering, together with the adoption of a low utility rate of return, will have the effect of putting the transporter out of the production and gathering business. Many transporters are even now looking to others for enlarged present and future supplies.

The business of producing and gathering natural gas is known and conceded to be a high risk business and we think should not be classed on the same basis with that of a public utility. The main factors to contend with in the utility operations are replacements due to depreciation, inadequacy, and obsolescence over long periods of time, as compared to rapid depletion and complete replacement of natural gas reserves, requiring exploration and discovery first, which is in itself a very hazardous undertaking.

Future Supply Problem

The future supply problem of the transporter is becoming particularly difficult due to the competition for the remaining reserves now undedicated and unsold in the presently proved fields, and the possibility of having to make long extensions to new fields. This problem is intensified by the deliverability difficulties brought about by proration. It is one of the important problems affecting the present and future welfare of the natural gas transporter.

Exploration and discovery, to create future supplies sufficient to take

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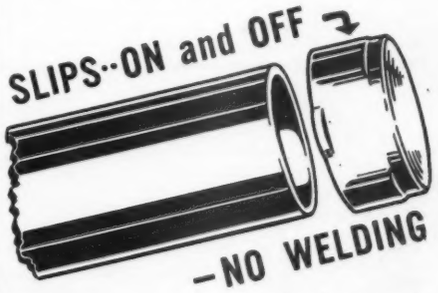

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care of ever-growing demands, present a major problem to the transporter. Change in the geographic location of new gas fields, requiring longer extension of field and main lines, and a continuing close study of the exploration by others, will be necessary to provide adequate supplies for future growing loads. Field price-fixing orders, which have already been made in Kansas and Oklahoma, have materially affected the costs of gas in the field. The decreasing ratio of transportation company produced gas, together with the renegotiation of purchase contracts, will cause further increased costs, which will have to be recognized by regulatory commissions and necessary rate adjustments effected if the industry is to remain on a sound financial basis.

Changed Supply Situation

There are those who have failed, to date, to recognize the rapid changes that recently have occured in the gas supply situation, and who assume that past performances can be continued. There also seems to be some serious doubt in the minds of the well-informed that it will be economically possible to fully satisfy the demand for gas in all the markets that are now available.

A recent Federal Power Commission release shows that the investment in the physical plant of 83 natural gas companies has increased 17.4 per cent over a 12-month period. It also shows that the net income of these same companies has increased only 9.3 per cent. A continuation of additional investment in facilities will require that the income keep pace with that of investment.

In many companies industrial markets have reached a degree of saturation that will prevent any substantial filling of additional valleys created by increased capacity. This means that many millions of dollars will be required to maintain pipe line capacity that cannot be utilized except for short periods during the cold weather.

Demand to Continue

Due to the very low comparative cost of natural gas as a fuel, we think that the consumer will continue to use this refined fuel because of its many advantages, even at substantially increased rates. It is thought that there will be no diminution in the demand for natural gas for space heating purposes even at considerably higher rates until practically one hundred per cent saturation is reached, provided the gas is made available.

One of the many important problems of the transporter is the mechanical and physical one of maintaining continuous service under all conditions. We, in the business, have to be on the alert to the abnormal and infrequent situations arising from line breaks, explosions, floods, and fires, which involve impairment of service for varying durations. Here again we are confronted with maintenance and replacement programs that have to be planned and executed well in advance of necessity. The operating organizations of natural gas pipe line systems deserve high praise for their record of continuity of service under all kinds of load, weather, and temperature conditions, and overcoming the difficulties of turning on and off gas wells in fields hundreds of miles from the market centers.

Planning Required

I have discussed briefly some of the principal winter supply problems of the transporter of natural gas. Satisfactory solution of these problems will require a great deal of intelligent planning for the future.

With such planning, I believe this challenge of satisfactorily supplying the natural gas market requirements will be met by all engaged in this business in the same fashion that private enterprise has solved its problems before. * * *

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FIG. 1. Automatic welding station with pipe storage rack in background to which 60-ft sections are shunted when completed at this station. The "Lincolnweld" head can be lowered when necessary to pass pipe over the area. The d-c generators for the unit are mounted in shallow cellars.

Double-Jointing 30-Inch Pipe With Automatic Hidden Arc Welding

RICHARD KILGORE*

THE automatic double-jointing of pipe with hidden arc welding to increase the speed of pipe line work is one of the latest developments in pipe line welding. New techniques for better handling and welding in this method are being worked out with each new job to which it is applied.

The best techniques by no means have been discovered and maximum efficiency will only evolve as more experience is gained. With this goal in mind, each new application of the method warrants serious examination.

One of the latest jobs to be done with hidden arc welding is at the plant of the Pacific Pipe Line Construction Company in Montebello, California, currently working on a contract for the Pacific Gas and Electric Company.

EXCLUSIVE

On this particular job, 30-ft lengths of 30-in. pipe are being double jointed to make 60-ft lengths. Fig. 1 shows the layout for the steps in the operation from the unloading of truck in the background to the final automatic welding in the left foreground.

The pipe ends are first ground with an abrasion wheel to remove rust and other foreign matter from the joint to be welded. Clean joints are essential to successful hidden arc welding.

*Welding engineer, The Lincoln Electric Company, Cleveland 1, Ohio.

FIG. 2. Electrically operated "bug" that creeps under power to the line-up position from one end of the pipe is shown here in position. When second pipe section is brought over, it will be expanded to line up the joint for the first stringer pass.

FIG. 3. First stringer pass is made with an E6010 electrode. Two welders make the pass. All-position welding is required. One hundred per cent penetration in the joint is insured by this operation. Arc is almost completely hidden in the joint of this 30-in. diam pipe.

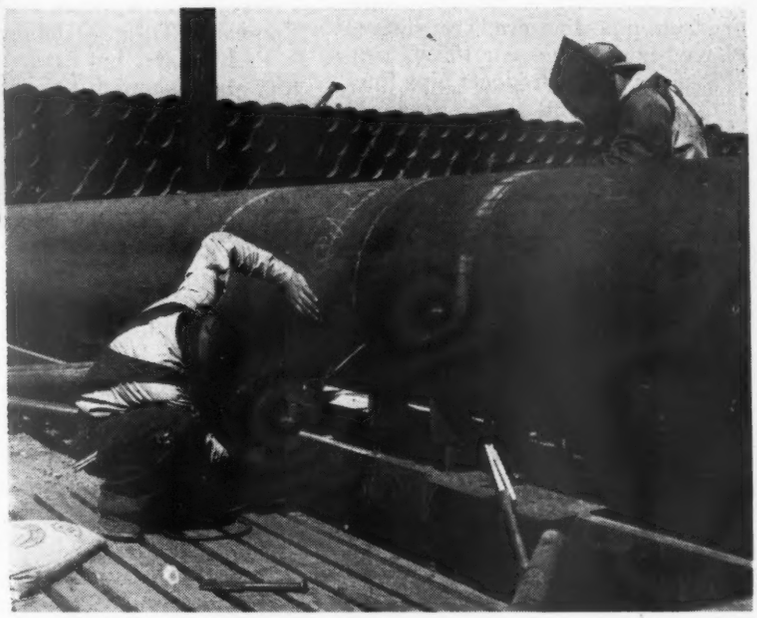

FIG. 4. After a second-hand pass is made with an E7010 electrode, the third and final pass is applied with the automatic hidden arc welding process. This final automatic pass is made with 750 amp and takes the place of what is ordinarily accomplished with two-hand passes. Seventy-five sections are welded in an 8-hr shift.

The pipe is then rolled into position on a fixture where the internal line-up clamp is put into the pipe to line up the joint for the stringer bead. The clamp is electrically driven to the line-up position from one end of the pipe. At this station two welders apply the first stringer bead, using an E6010 electrode. One hundred per cent weld penetration is obtained in the joint by this operation. All-position welding is required.

The pipe then goes to the next position where another hand pass is made on a rotating fixture, using an E7010 electrode. The section is now ready for the automatic station where the final pass is applied. The automatic weld completes what is ordinarily done in two hand passes.

The hidden arc welding is done with a standard "Lincolnweld" head, manufactured by The Lincoln Electric Company of Cleveland, Ohio, using a 7/32-in. diam electrode wire at 750 amp and 30-31 volts. With this set-up, 75 complete sections of pipe are welded in an 8-hr shift. ★ ★ ★

API Pipe Line Papers Cover Wide Range of Subjects

A PIPE LINE SYMPOSIUM, sponsored by the Division of Production, was held during the 29th Annual Meeting of the American Petroleum Institute in Chicago. The following are abstracts of most of the technical papers delivered.

"History and Development of Products Pipe Lines." **John W. de Groot,** president, Tuscarora Oil Company, Ltd., Harrisburg, Pennsylvania.

The paper cites early developments in natural gasoline pipe lines as a factor contributing to the start of the "products pipe line era," considered to have begun in the year 1930.

Pioneer refined products pipe lines of the early 1930's are discussed briefly, with emphasis on the factors sparking their beginnings.

The paper presents a series of data, spaced at 5-year intervals from 1930 to date, covering mileage, pipe size, and barrels transported on an industrywide basis. Certain trends established during the rapid growth of the country's products pipe line network are pointed out.

Maps showing the extent and location of products pipe lines at the end of these same 5-year intervals are reproduced as a series of "growth" maps.

"Field Performance of Modern Asphaltic Pipe Coatings." **Gordon N. Scott,** pipe-line technologist and consulting engineer, Los Angeles, California.

Modern equipment and methods of applying protective coatings and of handling coated pipe in the field have resulted in highly efficient coatings. Much of this improvement has been jointly accomplished by close cooperation between the engineers and the coating and laying contractors.

This readily procured high efficiency makes possible, and invites, periodic electrical examinations of the coatings to insure almost perfect coating continuity at all times and, thus, maximum protective value.

The underlying theory and technique of the several measurements are discussed, particular emphasis being given to the Pearson coating-discontinuity locator. Typical examples of field results are given and interpreted in terms of errors of design as well as of construction.

"The Values of Vocational Training in the Pipe-Line Industry." **J. R. Mills, Jr.,** Standard Oil Company (Indiana), Chicago, Illinois.

This presentation emphasizes the need of recognizing and taking into consideration the entire job environment of workers in the setting up of a vocational-training program. Some of the values that accrue are: Increased job skills; reduction in waste, overtime, and maintenance costs; reduction in grievances; improved morale; and better understanding of the free-enterprise system.

"Control of Vapor-Zone Corrosion in Storage Tanks by the Use of Ammonia." **F. T. Gardner** and **A. T. Clothier,** of The Carter Oil Company, Tulsa, Oklahoma, and **Francis Coryell,** of Interstate Oil Pipe Line Company, Tulsa, Oklahoma.

Preliminary, but extensive, laboratory study showed that hydrogen sulfide corrosion could be retarded by ammonia in a concentration of one-tenth of that necessary to neutralize the "sour gas." Initial field studies in lease tanks, utilizing ammonium carbonate as a source of ammonia, were encouraging, but not entirely conclusive, say these authors. Testing was extended to pipe line storage tanks employing anhydrous ammonia, and the degree of protection obtained was very high. Use of anhydrous ammonia has proved to be an economical method of quickly achieving protection of the vapor zone. Interstate Oil Pipe Line Company is now using ammonia to protect sour crude tankage in several areas.

"Pressure-Surge Tests on Oil Pipe Lines." **J. E. Green,** of Shell Pipe Line Corporation, Houston, Texas.

This paper describes the field test work, the results, and the conclusions of a pressure surge investigation that was made by a committee organized by several of the companies having interests in the proposed large-diameter Middle East pipe lines.

In the design of the present-day large-diameter thin-walled pipe lines, the various strength safety factors have been evaluated closely to permit a greater allowable working stress of the metal. Some of the engineers responsible for the design of these large lines felt that surge pressures developed during pump station start-up and shutdown, and by valve operation, should be thoroughly investigated so that a surge pressure allowance could be evaluated.

The surge investigation included tests on three existing pipe lines. Pressure surges were created by opening and closing valves and by starting and stopping centrifugal pumps. Pressure and flow were measured with high-speed recording devices that were placed at intervals along the test lines. All records were coordinated by radio to a common time base. The immediate aim of the tests was to determine speed of surge travel, magnitude of surge pressure, shape of surge waves, and the natural attenuation of surges.

Swigart Elected Vice President for Transportation API

The directors of the American Petroleum Institute elected Theodore E. Swigart, Shell Pipe Line Corporation, Houston, Texas, vice president for transportation, at the annual meeting in Chicago. The Division of Transportation in session November 9, elected 45 elective members of the general committee as follows:

P. R. Applegate, The Buckeye Pipe Line Company, New York, New York; Munger T. Ball, Sabine Transportation Company, Port Arthur, Texas; T. H. Barton, Lion Oil Company, El Dorado, Arkansas; Paul J. Bond, The Pure Oil Company, Chicago, Illinois; T. E. Buchanan, The Texas Company, New York; B. C. Clardy, Standard Oil Company (Indiana), Chicago; J. J. Coney, Hilcone Steamship Company, San Francisco, California; James J. Cosgrove, Continental Oil Company, Ponca City, Oklahoma; L. R. Cowles, Standard Oil Company, (Indiana), Chicago;

J. C. Donnell, II, The Ohio Oil Company, Findlay, Ohio; C. F. Dowd, Tide Water Associated Oil Company, New York; Robert G. Dunlop, Sun Oil Company, Philadelphia, Pennsylvania; James E. Dyer, Sinclair Refining Company, New York; S. H. Elliott, Sohio Pipe Line Company, Cleveland, Ohio; P. L. Fahrney, Standard Oil Company of California, San Francisco; R. D. Gibbs, Union Oil Company of California, Los Angeles, California; H. A. Gilbert, Oil Transfer Corporation, New York;

B. C. Graves, Union Tank Car Company, Chicago; R. V. Hanrahan, Humble Pipe Line Company, Houston, Texas; C. C. Herndon, Skelly Oil Company, Tulsa, Oklahoma; George H. Hill, Jr., Cities Service Company, Inc., New York; D. B. Hodges, Shell Oil Company, Inc., New York; B. B. Howard, Standard Oil Company (New Jersey), New York; D. A. Hulcy, Lone Star Gas Company, Dallas, Texas; D. D. Irwin, The Pure Oil Company, Chicago; L. M. Jonassen,

Cleveland Tankers, Inc., Cleveland;

P. H. Kuhns, Continental Oil Company, Ponca City; J. L. Latimer, Magnolia Petroleum Company, Dallas; Gavin W. Laurie, The Atlantic Refining Company, Philadelphia; F. W. Littell, Shell Pipe Line Corporation, Houston; H. A. McKim, Standard Oil Company of California, San Francisco; R. B. McLaughlin, The Texas Pipe Line Company, Houston; R. L. Minckler, General Petroleum Corporation, Los Angeles; Harry Moreland, Great Lakes Pipe Line Company, Kansas City, Missouri;

C. R. Musgrave, Phillips Petroleum Company, Bartlesville, Oklahoma; S. F. Niness, Leaman Transportation Company, Downingtown, Pennslyvania; J. P. Patterson, Pan American Petroleum and Transport Company, New York; J. H. Peper, The Buckeye Pipe Line Company, New York; J. A. Polhemus, Jr., Standard Oil Company of California, San Francisco; F. R. Pratt, Socony-Vacuum Oil Company, Inc., New York; H. G. Schad, The Atlantic Refining Company, Philadelphia; John E. Selden, Bradford Transit Company, Bradford, Pennsylvania; J. W. Sinclair, Union Oil Company of California, Los Angeles; E. R. Turner, Pan American Pipe Line Company, Houston; C. R. Younts, Plantation Pipe Line Company, Atlanta, Georgia.

Of these the division named J. C. Donnell, II, vice chairman, and James E. Dyer, secretary.

The president, Baird H. Markham, appointed five members of the board of directors to serve on the general committee, Division of Transportation, as follows: B. Brewster Jennings, Socony-Vacuum Oil Company, Inc., New York; Charles S. Jones, Richfield Oil Corporation, Los Angeles; H. T. Klein, The Texas Company, New York; N. C. McGowen, United Gas Pipe Line Company, Shreveport, Louisiana, and S. A. Swensrud, Gulf Oil Corporation, Pittsburgh, Pennsylvania.

Standard Completes Submarine Line

Standard Oil Company has recently completed the laying of a 2500-ft submarine line one mile south of Carpinteria, California. The line will be used to unload gasoline from ocean tankers. Appurtenant facilities are being constructed for storage purposes, which includes the erection of four tanks that will have a total capacity of 80,000,000 bbl. This work is to be completed by spring.

Kinsolving New Head Pipe Liner's Club

At a banquet and annual meeting of The Pipe Liner's Club, held in the Blackstone Hotel, Chicago, during the meeting of the American Petroleum Institute, new officers were elected. W. C. Kinsolving, president of Sun Pipe Line Company (Texas) and Susquehanna Pipe Line Company, was chosen as new head of the organization. J. H. Peper, president, The Buckeye Pipe Line Company, New York City, was elected vice president, and Oliver C. Klinger, president, Oildom Publishing Company, Bayonne, New Jersey, secretary.

New members elected to the board of governers are: T. E. Swigart, president, Shell Pipe Line Corporation, Houston, Texas; J. L. Burke, president, Stanolind Pipe Line Company, Tulsa, Oklahoma, and Loren F. Kahle, president, Interstate Oil Pipe Line Company, Tulsa.

Contractors to Meet Dec. 14

The Pipe Line Contractors Association will hold its annual meeting in Houston, Texas, December 14, 1949, at the Shamrock Hotel, it has been announced from association headquarters in Dallas.

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ACE HIGH PERFORMERS

With CLEVELANDS on hand, you're sure to win for you can absolutely depend on your trench being "ON TIME—EVERY TIME". CLEVELANDS dependable performance on the oil field jobs—transmission lines, gathering lines, distribution lines or stripping pipe—is due to fine balance on full-crawlers, fine engineering and rugged high quality unit-type construction. Built into every CLEVELAND are the speed, power, maneuverability, mobility, strength and economy that deliver "ACE HIGH PERFORMANCE AT ROCK BOTTOM COSTS". See your local distributor now!

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Trainload California Pipe Delivered in Texas

A trainload of line pipe manufactured in California was delivered in Texas recently from a new source of supply for the expanding pipe line industry.

The 60-car train represents part of a large order of steel pipe purchased by Texas Eastern Transmission Corporation of Shreveport, Louisiana, from Kaiser Steel Corporation of Oakland, California. The single shipment contained enough 20-in. pipe for a 9½-mile section of a line, which the transmission firm is laying in eastern Texas and Louisiana.

The pipe was fabricated by the steel division of the Basalt Rock Company at Napa, California, from plate rolled at Kaiser Steel's plant at Fontana, California. It was shipped under a fabrication-in-transit rate granted by the Southern Pacific and other western railroads.

This shipment was one of the first large orders received since Kaiser Steel and Basalt Rock Company recently announced their decision to work together in the production of large diameter steel line pipe.

The Napa plant is equipped with high-speed presses and other machinery, much of it designed by Basalt's own engineers, to produce high-quality pipe in lengths up to 40 ft and in diameters up to 30 in. New machinery now being installed to turn out material in even larger diameters will be in operation early in 1950, Jack L. Ashby, vice president and general manager of Kaiser Steel, said.

Kaiser Steel also is supplying all the steel plate for the fabrication of pipe for the Transcontinental pipe line, which will carry gas from Texas to New York City, a distance of 1840 miles.

Loaned to Imperial

Jack L. Byrd, Tulsa, Oklahoma, has been loaned by Interstate Oil Pipe Line Company to Imperial Oil Ltd., Toronto, Canada.

Radio Problems Discussed

The petroleum industry was told at the annual American Petroleum Institute meeting that it can reduce its radio-interference problems to a minimum through continued self-regulation and future planning. Commissioner E. M. Webster of the Federal Communications Commission said, "This need for self-regulation extends not only to choosing a frequency in the first instance, but also to policing your own operators in their day-to-day use of the air waves."

Transportation Division Awards Certificates

The Division of Transportation of the American Petroleum Institute presented certificates of appreciation to five men at API's annual meeting.

The certificates were presented by W. Alton Jones, of New York API vice president for transportation, at a group session of transportation men in the Palmer House. The recipients of the certificates were:

James Cook Bennett, now retired, formerly with Tide Water Associated Oil Company, San Francisco, for service rendered as a member, as vice chairman, and as chairman of the central committee on automotive transportation.

Douglas Stewart Bushnell, now retired, formerly with Northern Group of Pipe Lines, New York, for service as chairman of the committee on valuation of pipe lines, as a member of the central committee on pipe line transportation, and as a member of the board of directors of the Institute representing pipe lines.

Porter L. Howard, Sun Oil Company, Philadelphia, for service rendered as a member and as vice chairman of the central committee on railroad transportation.

Harry Gordon Schad, the Atlantic Refining Company, Philadelphia, for service as a member, as vice chairman, and as chairman of the central committee on transportation by water.

Theodore Earl Swigart, Shell Pipe Line Corporation, Houston, for service rendered that led to the formation of the central committee on radio facilities.

New Officers of AGA Are Chosen

Hugh H. Cuthrell, vice president of The Brooklyn Union Gas Company, Brooklyn, New York, is the new president of the American Gas Association. D. A. Hulcy, president, Lone Star Gas Company, Dallas, Texas, has been chosen first vice president; George F. Mitchell, president, The Peoples Gas Light and Coke Company, Chicago, Illinois, second vice president, and Edward F. Barrett, president, Long Island Lighting Company, Mineola, New York, treasurer.

Directors for two-year terms are:

Edward G. Boyer, manager, gas department, Philadelphia Electric Company, Philadelphia, Pennsylvania.

H. R. Cook, Jr., vice president Consolidated Gas Electric Light and Power Company of Baltimore, Maryland.

E. H. Eacker, president, Boston Consolidated Gas Company, Boston, Massachusetts.

Joseph N. Green, president, Alabama Gas Corporation, Birmingham, Alabama.

Stanley H. Hobson, president, Geo. D. Roper Corporation, Rockford, Illinois.

R. H. Lewis, president, Ruvd Manufacturing Company, Pittsburgh, Pennsylvania.

Frederick A. Lydecker, vice president in charge of gas operation, Public Service Electric and Gas Company, Newark, New Jersey.

J. F. Merriam, executive vice president, Northern Natural Gas Company, Omaha, Nebraska.

Dean H. Mitchell, president, Northern Indiana Public Service Company, Hammond, Indiana.

James S. Moulton, vice president and executive engineer, Pacific Gas and Electric Company, San Francisco, California.

J. French Robinson, president, The East Ohio Gas Company, Cleveland, Ohio.

Paul R. Taylor, vice president, Consolidated Electric and Gas Company, New York, New York.

Thomas Weir, general manager, Union Gas Company of Canada, Ltd., Chatham, Ontario.

Harry K. Wrench, president and general manager, Minneapolis Gas Company, Minneapolis, Minnesota.

Charles G. Young, vice president, Springfield Gas Light Company, Springfield, Massachusetts.

C. H. Zachry, president, Southern Union Gas Company, Dallas, Texas.

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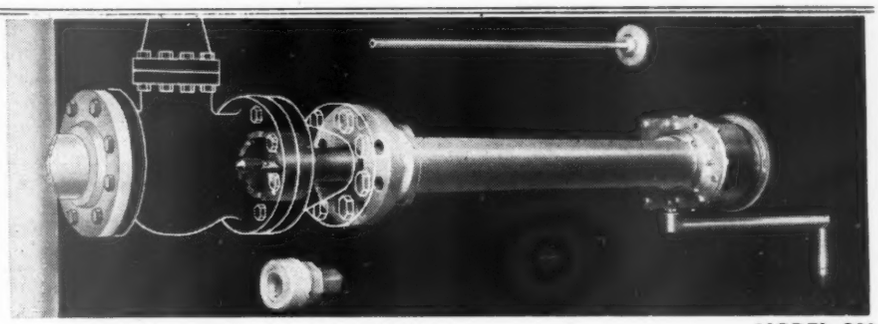

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Nominal cutter sizes 1½" to 4". Ball and roller bearings in all main journals.

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*Patent No. 2,097,398
Other Patents Pending

Common Carrier Service

A Federal Power Commission Presiding Examiner has issued an initial decision, subject to Commission review, ordering Montana-Dakota Utilities Company to perform "common carrier" natural gas transmission service for Mondakota Gas Company.

Examiner Maximilian G. Baron directed Montana-Dakota to connect its transmission facilities with a pipe line of Mondakota Gas Company near a Montana gas well, and accept up to 500,000 cu ft of gas daily for transportation to the Eastern Clay Products Company plant near Belle Fourche, South Dakota.

Socony Christens Tanker

Mrs. John F. Seal, wife of Vice President Seal of Socony Vacuum Company, christened the super tanker *S.S. Sovac Astral* October 20. The launching was one of the most successful in recent months, with John G. Pew, president of Sun Ship, in charge of ceremonies.

The *S.S. Sovac Astral* is seventh of the super tankers constructed in the shipyard. She is more than 600 ft long and has a cargo capacity of about 231,000 bbl of oil. Pew said the ship is third of the super tankers ordered by Tankers Navigation Company, Inc.

Tulsa Pipe Liners Club Completes Year of Growth

The Pipe Liners Club of Tulsa has completed its first year of existence in a quite successful manner. Organization of the Pipe Liners Club was effected in September, 1948, when the 20 charter members representing 10 pipe line companies in the Tulsa area adopted the constitution and elected the first officers.

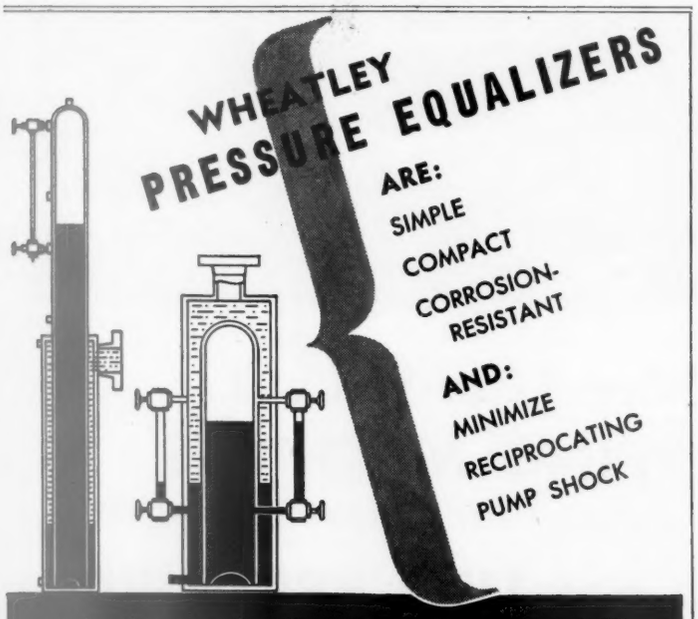
Papers on technical or operational problems are presented at monthly dinner meetings and followed by discussion periods. Most of these meetings are held at the Mayo Hotel at Tulsa; however, one has been held in Cushing. The next meeting is scheduled for Bartlesville, where headquarters for some of the companies represented in the club membership are maintained. Occasionally, motion pictures are presented that are related to the pipe line industry.

New officers have been elected for the year 1949-1950 and they took office in the October meeting of the club. The officers and directors who will serve for the year 1949-1950 are as follows:

President, P. L. Reichard, assistant general superintendent, Gulf Refining Company, Pipe Line Division, Tulsa, Oklahoma; vice president, J. D. Jones, master mechanic, Gulf Refining Company, Pipe Line Division, Tulsa, Oklahoma; secretary, F. C. Whiteside, assistant chief engineer, Interstate Oil Pipe Line Company, Tulsa, Oklahoma; treasurer and assistant secretary, C. G. Billings, assistant area superintendent, Shell Pipe Line Corporation, Cushing, Oklahoma.

Board of directors: F. V. Cook, master mechanic, Stanolind Pipe Line Company, Tulsa, Oklahoma; C. P. Jennings, chief engineer, Products Pipe Line Division, Phillips Petroleum Company, Bartlesville, Oklahoma; T. D. Williamson, Jr., vice president, T. D. Williamson, Inc., Tulsa, Oklahoma; J. L. Cahill, chief engineer, Continental Pipe Line Company, Ponca City, Oklahoma.

Qualifications for membership are based on active participation in pipe line engineering, consultation, or design, or in the responsible supervision of construction or operation of pipe lines. Membership, to a limited number, is also extended to suppliers who are actively engaged in the sale of pipe line supplies and equipment and services. The membership of the club has grown during this first year of its existence from the initial 20 charter members to 121 members at present.



Wheatley pipe line pressure equalizers incorporate the principle of the air chamber without the objectionable features. Inert sealing fluid prevents air escape, minimizes formation of gum and corrosion. In successful use for ten years by major companies. Operating locations will be furnished on your request.

FRANK W WHEATLEY

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WRITE FOR LATEST "PUMPER" AND EQUALIZER BUL. CC436

New Members of Pipe Liners Club

Wallace K. Luse, engineer with Interstate Oil Pipe Line Company, Tulsa, recently became a member of The Pipe Liners Club of Tulsa. Other new members include J. S. Hale, Valuation Unit Head, Gulf Refining Company, Tulsa, and E. P. Shelton, district manager of Chicago Bridge and Iron Company.

Appoint Wallgren to FPC

Mon C. Wallgren has become a member of the Federal Power Commission for the term expiring June 22, 1945. Wallgren formerly was governor of the State of Washington, prior to which he had served as U. S. senator and representative from that state. He was a member of the U. S. House of Representatives from March 4, 1933, until December 19, 1940, when he resigned to take his seat in the Senate. A good friend of Truman, the President named him to the new position.

Murrey to Head NACE Exhibits

O. E. "Ted" Murrey, president of Midwestern Engine and Equipment Company, Tulsa, Oklahoma, has been made chairman of the exhibits committee of the National Association of Corrosion Engineers for the second successive year. The 1950 NACE Conference and Exhibit will be held in St. Louis, Missouri, April 3-7.

Panhandle Eastern Buys Trunkline Stock

Panhandle Eastern Pipe Line Company has acquired 60 per cent of the outstanding stock of Trunkline Gas Supply Company, according to a joint statement issued by W. G. Maguire, chairman of Panhandle, and Ralph K. Davies, president of Trunkline.

Trunkline already holds a certificate of public convenience and necessity issued by the Federal Power Commission to construct a pipe line from Texas and Louisiana to a point in Nebraska.

TRANSPORTATION PERSONALS

▸ **J. Lyell Wilson,** research director, American Bureau of Shipping, has applied for retirement on January 1, 1950, prior to his normal retirement date. The American Bureau of Shipping has acceded to this request in accordance with provisions of its group annuity and retirement plans. Wilson will shortly enter upon a leave of absence prior to his retirement.

▸ **Victor N. Staab** has been transferred from Hays, Kansas, to Stafford and made district gauger by Stanolind Pipe Line Company.

▸ **Glenn L. Pool** is one of five new engineers recently added to the engineering department of El Paso Natural Gas Company at the main office of the company in El Paso, Texas. He is from Moran, Texas, and received his degree from New Mexico A. & M. **Mack Atcheson** is from Lubbock, Texas, graduated from Texas Tech, and was employed by the Elliott Company of Jeannette, Pennsylvania, before joining the gas company. **Clinton McClure** is from Clovis, New Mexico, and also is a graduate of New Mexico A. & M. **Taylor H. Jackson** likewise is a New Mexico A. & M. graduate. He is from Sioux City, Iowa. **William L. Fugate** is a graduate of Texas Western College and worked at El Paso Gate while attending school.

▸ **Clyde Wyant,** vice president of Midwestern Constructors, Inc., Tulsa, Oklahoma, has been appointed general superintendent in charge of all construction work, President F. E. Stanley has announced. Wyant has been general superintendent directing station construction but now will also be in full charge of pipe line construction jobs. It was also announced that **Howard S. Lipp** has been moved from Chicago to Tulsa as assistant general superintendent. **Lyle S. DeWitt** has been made assistant general superintendent for station construction.

▸ **T. B. Davis,** meter inspector in the Wichita Falls, Texas, area for United Gas Pipe Line Company, has been transferred to the main office in Shreveport, Louisiana, and in the future will serve in the contracts and right-of-way department.

J. M. Wright, chief engineer at Conroe compressor station in the Houston district, has been transferred to the Iowa, Louisiana, compressor station as chief engineer.

▸ **L. R. Owen** will become manager of the foreign shipping department of Socony-Vacuum Oil Company, Inc., on January 1. He succeeds the late **J. T. Lockwood. H. R. Arnold,** general manager of the company's Levant division, will become a member of the foreign trade committee in charge of Turkey and Greece, succeeding Owen.

▸ **W. T. Pyott,** who has been assistant to the chief engineer, Great Lakes Pipe Line Company, Kansas City, Missouri, resigned recently to accept a position as head of the pipe line construction department of Fred Mannix Company, Ltd., Calgary, Alberta, Canada.

▸ **Merrel N. Johnson,** former maintenance mechanic at Hansford station of Panhandle Eastern Pipe Line Company, has been assigned the engineer's job at Satanta station.

W. C. McGee Jr.

Joe J. King

▸ **W. C. McGee, Jr.,** has been named general superintendent of operations of the Tennessee Gas Transmission Company and **Joe J. King** has been made chief engineer, according to an announcement by **Charles S. Coates,** company vice president.

McGee formerly was chief engineer and King was industrial sales engineer. Both have had considerable experience in the operating and engineering phases of the natural gas pipe line system of the Tennessee Gas Transmission Company and with the pipe line systems of other companies.

In their new positions, McGee will have general supervision over pipe line and compressor operation and maintenance, gas measurement, and dispatching and King will have general supervision over all engineering functions, including design, drafting, material control, and surveying.

McGee is a graduate in civil engineering of Texas A & M College and King is a graduate in mechanical engineering from University of Texas.

James E. Moss

▸ **James E. Moss,** director of the Division of Transportation of the American Petroleum Institute, was awarded the U. S. Navy's "Distinguished Public Service Award" at the API's 29th annual meeting in Chicago.

Moss received the award—the highest honor that the secretary of the navy can confer on a civilian—at a special ceremony in the Palmer House, where the Division of Transportation held a group session.

The award, and the lapel pin that accompanies it, were presented to the API director in recognition of his outstanding work during the war years as a port and tanker consultant for the coast guard and the navy.

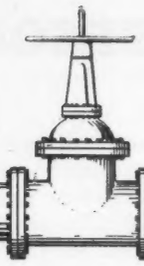
Rear Admiral Merlin G. O'Neill, assistant commandant of the coast guard, and Admiral H. C. Shepheard, chief of the office of merchant marine safety, USCG, bestowed the award on Moss in behalf of the coast guard commandant, Admiral J. G. Farley, and the secretary of the navy.

He created and developed a system for reporting and analyzing war casualties to merchant ships, and prepared a number of effective safety procedures and methods that were used widely during the war years. He also made the original draft of the national code of regulations for the security of vessels in port, developed a successful ballast-handling procedure for naval and merchant vessels, and helped establish the policy for the investigation of the failure of welded ships, and methods for preventing such failures.

Admiral Farley saluted him for his "exceptional ability and untiring efforts."

Moss has been head of the API's Division of Transportation since it was established in January, 1946. In addition he is manager of the API's Washington office.

PIPE LINE PROJECTS



Atomic Energy Line Completion in December

A 170-mile natural gas pipe line to supply the Atomic Energy Plant at Oak Ridge, Tennessee will be completed in December at a cost of approximately $10,000,000, according to an announcement by Ebasco Services Incorporated.

Ebasco Services, which have designed the line and are supervising its construction, said the 22-in. pipe line will initially deliver 60,000,000 cu ft gas daily to Oak Ridge atom plant.

"Because of this line's importance to the national security, the pipe is being equipped with fully automatic main line valves and will be buried throughout its entire length to minimize the possibility of sabotage," the announcement stated. "No exposed spans will be permitted and multiple crossings will be provided at the major rivers to be encountered."

Starting point of the line, which is being constructed by the Oman Construction Company, is at Greenbriar, Tennessee. It will have a capacity of 230,000,000 cu ft daily. In addition to supplying Oak Ridge, the line is expected to bring natural gas to the Knoxville, Alcoa, and Maryville area of eastern Tennessee this winter. The Federal Power Commission has been asked to approve construction of an 18-mile 16-in. line, an extension of the Oak Ridge line, to supply these cities.

Contracts Let for Interprovincial Line

Contracts for supplies and construction totaling more than $41,000,000 have been let to date by Interprovincial Pipe Line Company for the 1150-mile pipe line from Edmonton to Superior, Loren F. Kahle, executive vice president, has announced.

"The problem of moving Alberta oil to new markets at low cost is so urgent that it is essential the pipe be in the ground by next fall," Kahle said. "We are getting on with the job as quickly as possible.

"Pipe line construction of this magnitude demands highly-trained, experienced supervisory staff and specialized equipment of a type not previously used on a large scale in Canada. We expect that 10 spreads of equipment will be in use at one time along the route, and the equipment in each spread will represent an investment by the contractor of about $750,000.

"Large numbers of men will be needed for the project and we have stipulated that wherever possible they be hired locally. While the prime contractors number only three, a number of sub-contractors will be required to complete the job on time. We have stipulated sub-contracts be let locally wherever possible."

Prime contract for the construction of the 450-mile Edmonton-Regina section of the line, where 20-in. pipe will be laid, will be held by the Canadian Bechtel Company associated with Fred Mannix of Calgary. The 340-mile Regina-Gretna section of 16-in. pipe will be laid by Williams Brothers. The 360-mile U. S. section of 18-in. pipe from Gretna to Superior will be constructed by Anderson Brothers.

Surveying and staking of the proposed route is being done by Underwood and McLellan of Saskatoon; aerial photos, by Photographic Survey Company, Ltd. of Toronto; excavating and grading at Edmonton by Doncaster Construction Company of Edmonton; grading, surfacing, and other preparatory work for the pump station at Ermine, Bird Construction Company, Ltd. of Winnipeg.

Total cost of laying the line, excluding materials, is roughly $14,700,000. Several contracts for construction and supplies are still to be let.

Steel plate is being rolled by The Steel Company of Canada, Ltd., at Hamilton, and is being made into pipe by Page-Hersey Tubes Ltd. at Welland. Pipe of 18-in. and 20-in. size is not made in Canada and this order was placed with A. O. Smith Corporation, Milwaukee, Wisconsin.

Atlantic Texas Line in Operation This Month

Atlantic Pipe Line Company plans to place in operation this month the 427-mile, 10-in. crude oil line from Crane County, Texas, to Harbor Island, near Corpus Christi. With pumping stations at Block 31 field in Crane County, Sonora, and Castroville initial capacity of the line will be 35,000 bbl daily. Addition of three stations will increase capacity to 47,000 bbl.

Details of Northern Natural's 1950 Plans

The Federal Power Commission willing, Northern Natural Gas Company proposes to increase its daily capacity in 1950 from 470,000,000 cu ft to 600,000,000 cu ft. The new facilities would include 35,200 compressor hp and 597 miles of pipe lines.

The following compressor installations would be made:

Three 1600-hp units at Sunray, Texas.

Two 1600-hp units at Beaver, Oklahoma.

Two 1600-hp units at Mullinville, Kansas.

Three 1600-hp units at Bushton, Kansas.

Three 1600-hp units at Clifton, Kansas.

Four 1600-hp units at Beatrice, Nebraska.

Three 1600-hp units at Palmyra, Nebraska.

Two 1600-hp units at a new station near Garden City, Kansas.

Construction of large diameter pipe lines is proposed as follows:

155 miles of 20-in. Garden City to Bushton.

72.5 miles of 26-in. (3rd line) north of Bushton.

43.4 miles of 26-in. (2nd line) northeast of Palmyra.

65.9 miles of 26-in. (2nd line) north of Oakland.

31.2 miles of 26-in. (2nd line) north of Ogden.

39.5 miles of 26-in. (2nd line) north of Ventura.

41 miles of 26-in. (3rd line) north of Ventura.

40.2 miles of 26-in. (2nd line) north of Sunray.

74.9 miles of 26-in. (2nd line) north of Beaver.

33.5 miles of 26-in. (3rd line) north of Mullinville.

The construction of these facilities will cost an estimated $51,840,000.

Cheyenne-Omaha Line

Pacific Pipe Line and Engineers, Inc., will make an engineering study for Frontier Refining Company of Denver, Colorado, of a proposed products line between Cheyenne, Wyoming, where the company has a refinery, and Omaha, Nebraska.

Piping Hot

AT 10° ABOVE ZERO

—Pipe takes on its Protective Overcoat

On the line, welded joints are coated with NO-OX-ID XX heated in a portable kettle and ragged on. No. 7 NO-OX-IDized Wrapper is applied and sealed with NO-OX-ID XX.

BECAUSE the wide range of NO-OX-ID consistencies provides excellent corrosion protection regardless of the weather, this 24″ natural gas line was coated and laid in near-zero temperatures. Primed and coated with hot applications of NO-OX-IDs, and then NO-OX-IDized Wrappers, this line, from past performance records, is assured of a minimum of ten years' service, without leaks or replacements.

NO-OX-IDs are versatile protective coatings for hot or cold climates, for hot or cold applications, easy to use under any conditions.

Completed section, with welds protected with NO-OX-ID, being laid. Outer wrapper is kraft paper for protection of coating in transit and during stringing.

NO-OX-ID IRON OXIDE RUST

Dearborn
Reg. U. S. Pat. Off.

THE LEADER IN RUST PREVENTIVES AND BOILER WATER TREATMENT

"Piping Hot," a new 16mm. sound movie in color on the use of hot applied NO-OX-IDs by stationary machines is available to companies, engineering clubs, or technical societies. Write for booking.

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418
MILES
By One Spread
in One Year
One pipeline spread of Latex Construction Company laid and took-up 418 miles of pipe during our fiscal year ending Nov. 30, 1948 . . . demonstrating the value of combining years of experience and specialization with a well integrated organization for more efficient pipeline construction.
The mileage of pipeline work done by this one spread was divided as follows:
Miles of Pipe laid, 16" and larger. . . . 306
Miles of Pipe laid, 8", 10" and 12" . . . 62
Miles of Pipe taken-up and reconditioned. 50
Latex CONSTRUCTION COMPANY
General Contractors
Oil-Gas-Gasoline-Water Pipelines
HOUSTON, TEXAS ATLANTA, GA.
L. H. Favrot — G. A. Peterkin —
L. W. Sharman — R. P. Gregory

Contracts Awarded for West Texas Pipe Lines

The Texas-New Mexico Pipe Line Company has awarded contracts for construction of approximately 61 miles of crude oil pipe lines in West Texas. Carl H. Dunn, Fort Worth, Texas, will build 40 miles of 10¾-in. from a point in Borden County to the Colorado City pump station of the Basin Pipe Line System. This work will begin about December 15.

Wright Construction Company, Lovington, New Mexico, has been let a contract to construct 16.08 miles of 6⅝-in. and 5.41 miles of 4½-in. line in southwestern Borden County and northwestern Howard County. This work is now under way.

United Gas Given Authority for Line

The Federal Power Commission has authorized United Gas Pipe Line Company, Shreveport, Louisiana, to construct a 26-mile pipe line with a capacity of 112,000,000 cu ft of natural gas per day to connect the Mud Lake, East Mud Lake, Holly Beach, and Cameron Meadows gas fields in Cameron Parish, Louisiana, with the company's system in east Texas.

The company will make the additional gas available to the Beaumont-Port Arthur area, which it now serves in Texas. United has entered into a contract to purchase the gas from Magnolia Petroleum Company.

Pump Station and Tank Farm Program Completed

Cities Service Pipe Line Company has completed modernization of three pump stations and tank farms in Kansas and Oklahoma. New facilities of the Boyer station at El Dorado, Kansas, Walnut station, south of Augusta, Kansas, and Cimarron station near Guthrie, Oklahoma, were placed in operation recently.

At Boyer station, a steel frame fire-resistant building has been erected adjoining a similar building owned by The Texas-Empire Pipe Line Company. The new structure houses two new centrifugal pumps driven by 200-hp electric motors, a common office, shop, locker room, and two small Texas-Empire pumping units. Work on the manifold and tank farm lines is also completed.

The former auxiliary pump building at Cimarron station has been remodeled and now houses three new pumping units similar to the Boyer units, an office, locker room, shop and sample grind-out room. Other construction completed includes the new manifold and tank farm lines.

The offices at both Boyer and Cimarron house control equipment for the pumping units and are isolated from the pump rooms by vapor-proof walls as a precaution against fires. Large glass panels in the office enable station personnel to command a full view of the pumping units.

At Walnut station, a 75-hp motor-driven displacement pump and a 60-hp motor-driven centrifugal pump have been installed. The pumping units, control equipment, and office are housed in a new prefabricated steel building. All station and tank farm piping is now ready.

Northern Natural Seeks To Expand Its System

Northern Natural Gas Company, Omaha, Nebraska, has filed an amended application with the FPC seeking authorization to expand the capacity of its natural gas transmission system north of Kansas by 130,000,000 cu ft per day to a total of 600,000,000 cu ft. Estimated overall cost of the project is $51,840,000.

Northern's original program as proposed in an application filed with FPC last March called for an increase of 60,000,000 cu ft per day from the presently authorized daily capacity of 470,000,000 cu ft. The company at that time proposed to construct about 327 miles of 24-in. pipe line in Kansas, Nebraska, and Iowa; to install 16,000 hp in compressor units, and to build a dehydration plant at Garden City, Kansas.

Under the amended application, the company plans to construct an additional 270 miles of pipe line, making a total of approximately 597 miles in Texas, Oklahoma, Kansas, Nebraska, Iowa, and Minnesota; to install an additional 19,200 hp, for a total of 35,200, and to use 26-in. pipe instead of the 24-in. pipe as originally proposed.

FPC Hearings Begin

A consolidated hearing before the FPC commences December 7 in Washington, D. C., on the applications of Transcontinental Gas Pipe Line Corporation, which is proposing to expand the capacity of its Texas-to-New York City natural gas pipe line now under construction, and South Jersey Gas Company, which is seeking authorization to build a pipe line in New Jersey in order to receive gas from Transcontinental.

Transcontinental plans to increase capacity of its line from 340,000,000 cu ft per day to 505,000,000 cu ft. The company estimated cost of the program at $50,386,000. South Jersey proposes to build 77 miles of pipe line designed to carry about 30,000,000 cu ft of natural gas per day.

Proposed Line Would Carry 30,000,000 Cu Ft

South Jersey Gas Company, of Atlantic City, New Jersey, has asked the Federal Power Commission to authorize the construction of 77 miles of pipe line in New Jersey, designed to carry an estimated 30,000,000 cu ft of natural gas per day.

The proposed pipe line would connect near Camden, New Jersey, with a lateral of Transcontinental Gas Pipe Line Corporation's Texas-to-New York City line, now under construction, and would extend to Atlantic City with laterals to the Glassboro, Bridgeton, Vineland, and Estelville areas.

South Jersey proposes to purchase 18,000,000 cu ft of gas per day from Transcontinental, of which 2,750,000 cu ft will be delivered to Jersey Central Power and Light Company through the Estelville lateral; 200,000 cu ft to The Bridgeton Gas Light Company through the Bridgeton lateral, and 1,250,000 cu ft to Cumberland County Gas Company through the Vineland lateral.

The remaining 13,800,000 cu ft, the company said, would be used to serve its own customers in Atlantic City, Glassboro, Hammonton, Pennsgrove, Pitman, Pleasantville, Ventnor, Vineland, and some 55 other smaller municipalities, and to deliver 2,000,000 cu ft per day on a firm basis to the Owens-Illinois Glass Company at Bridgeton.

Magnolia to Build West Texas Pipe Line

Magnolia Pipe Line Company will lay a 23-mile 8-in. trunk line extension from its terminal near Midland, Texas, south to the Pegasus area on the Midland-Upton County line. The area, which was discovered in March, now has four Ellenburger producers. A 6-in. gathering system will be laid. laid.

Texas Eastern Amends New England Application

Texas Eastern Transmission Corporation, of Shreveport, Louisiana, has filed an amended application with the Federal Power Commission for authorization to construct pipe line facilities that would make available up to 200,000,000 cu ft of natural gas per day to the New England area. Estimated cost of the project is $63,684,100.

Texas Eastern, which operates the Big and Little Big Inch lines, is proposing to construct a 30-in. loop pipe line along its present rights-of-way between Lebanon, Ohio, and Connellsville, Pennsylvania, a distance of about 255 miles; a 255-mile, 26-in. pipe line extending from a point near Lambertville, New Jersey, to the Boston, Massachusetts, area; about 292 miles of lateral lines extending from various points on the New Jersey-Boston line to points in Connecticut, Rhode Island, Massachusetts, and New Hampshire; and additional compressing facilities, having an aggregate installed horsepower of 49,200, at eight stations along its main line between Ohio and New Jersey.

The company said the proposed construction would increase the overall capacity of its pipe line system to 940,000,000 cu ft per day, and estimated demands for daily deliveries in the New England area as ranging from a minimum of about 50,000,000 cu ft to a maximum of approximately 200,000,000 cu ft.

Shell to Lay 40-Mile Line in West Texas

Shell Pipe Line Corporation will lay 40 miles of 10-in. crude oil line from its terminal at McCamey, Texas, to Humble Pipe Line Company's Kemper terminal near the Big Lake field. The line will have a daily capacity of 40,000 bbl.

Trunkline Proposes 740-Mile Pipe Line

Trunkline Gas Supply Company has submitted to the Federal Power Commission a proposal to construct a 740-mile Louisiana-to-Illinois pipe line designed to carry about 250,000,000 cu ft of natural gas per day for delivery to Panhandle Eastern Pipe Line Company. Estimated overall cost of the project is approximately $85,000,000.

The construction plan was set forth in a petition for amendment of the commission's April 29, 1949, order, which authorized Trunkline to build a 711-mile pipe line from Edge, Texas, to Palmyra, Nebraska, for the purpose of supplying 250,000,000 cu ft of natural gas per day to Northern Natural Gas Company.

In its petition, Trunkline said that Northern Natural has refused to enter into a written agreement covering the purchase and sales of the gas, but that Trunkline recently concluded an agreement with Panhandle covering the sale for a 20-year period of the 250,000,000 cu ft.

The proposed construction includes the 740-mile 26-in. main line, which would extend from a point near Longville, Louisiana, to Panhandle's Tuscola, Illinois, compressor station; installation of 32,000 hp in main line compressor stations, and lateral supply lines substantially as already authorized in FPC's April order.

Needs More Crossings At Greenville, Mississippi

Tennessee Gas Transmission Company, of Houston, Texas, has requested Federal Power Commission authorization to install four 26-in. pipe lines on the Mississippi River highway bridge at Greenville, Mississippi, and an additional 28,800 ft of 26-in. pipe to connect the bridge crossing with the company's natural gas transmission system on either side of the river.

The company said that installation of the four pipe lines would involve reinforcing the present bridge structure so as to provide sufficient load carrying capacity. Estimated overall cost of the construction program is $2,355,880, of which $944,000 would be spent for the bridge reinforcement program.

Tennessee said that its entire delivery capacity of about 600,000,000 cu ft per day is now transported through two 18-in. pipe lines on the Greenville Highway bridge, which are of inadequate capacity for the river crossing. The four additional pipe lines are necessary to transport the proposed daily gas volumes that will be delivered at this river crossing upon the completion of new pipe line facilities now under construction and will assure uninterrupted service to Tennessee's customers. The company said the proposed facilities would not increase the daily delivery capacity of its pipe line system.

Gulf Announces Plans For a 200-Mile Line

Gulf Refining Company, Pipe Line Division, has announced plans to construct a 200-mile 16-in. crude oil line from the Heidelberg-Eucutta district, Jasper County, Mississippi, to Mobile, Alabama, via the Baxterville field. At Mobile a tank farm and loading terminal will be erected.

Integrated Pipe Line Facilities Approved

Consolidated Edison Company of New York, Inc., the Brooklyn Union Gas Company, and Kings County Lighting Company, have been authorized by the Federal Power Commission to construct integrated natural gas pipe line facilities in the New York metropolitan area.

The facilities involve a total of approximately 38 miles of pipe line to be built at an estimated aggregate cost of $12,723,000, and will carry about 194,500,000 cu ft of natural gas per day to be delivered by Transcontinental Gas Pipe Line Corporation after completion of its Texas-to-New York City pipe line project.

PICTORIAL

Left, at a regular meeting of Ohio Oil Company's pipe line department superintendents, Eastern divisions, are, left to right: A. B. Johnson, chief engineer; Fred H. Warren, general superintendent; Perry Thompson, division superintendent, Lima; Earl Mardis, division superintendent, Bridgeport; O. F. "Mike" Moore, standing, manager of the pipe line department; R. M. Slough, superintendent of communications; Oscar Jaco, division superintendent, Martinsville; Joe Dean, supervisor of personnel.

Cities
of its

The fourth annual banquet and meeting of The Pipe Liners' Club was held in the lackstone

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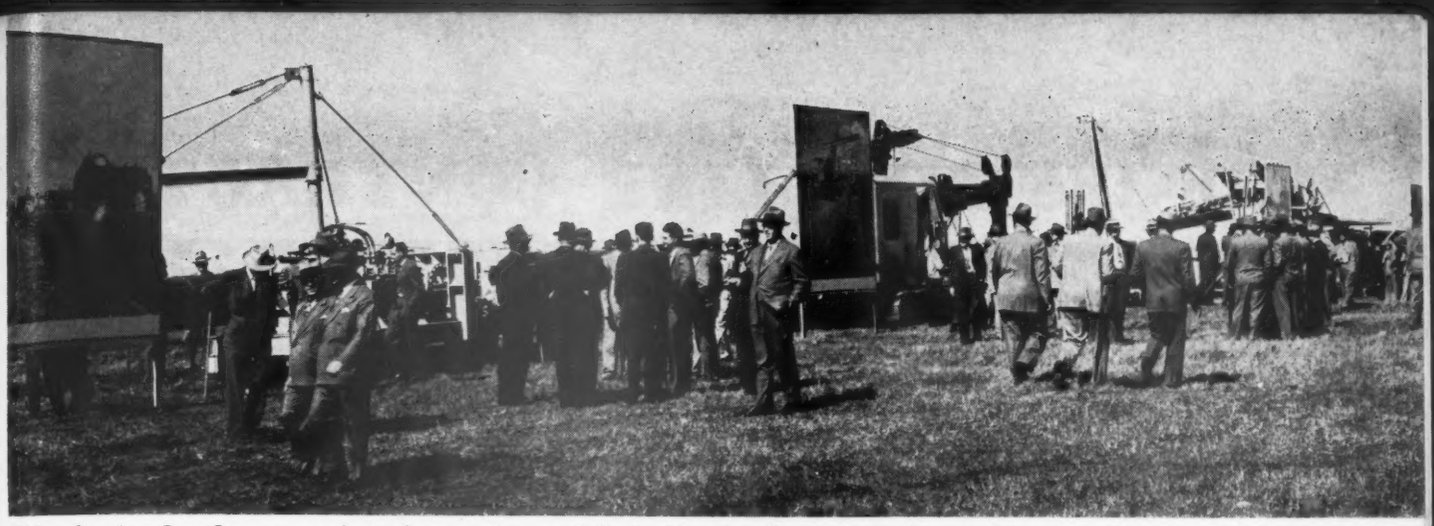

Cities Service Gas Company adopted a novel way of displaying pipe line construction equipment at the recent dedication of its new 26-in. line near Lenexa, Kansas. A large-scale action picture was shown beside each piece of machinery.

lackstone Hotel, Chicago, during the meeting of the American Petroleum Institute.

With the PIPE LINE CONTRACTORS

Oklahoma Contracting Company, 1210 Mercantile Bank Building, Dallas, Texas, has shut down its work until next spring (April or May) on the Salt Lake Pipe Line Company job due to unsuitable weather conditions. Approximately 100 miles of the 151-mile section between Burley and Boise, Idaho, has been laid. The 102-miles of 26-in. being laid for Texas Gas Transmission Corporation from Fulton to Providence, Kentucky, has been completed.

Carl H. Dunn, Burkburnett Building, Fort Worth, Texas, will lay 40 miles of 10-in. for The Texas-New Mexico Pipe Line Company from a point in Borden County, Texas, to the Colorado City pump station of the Basin Pipe Line System. Work is expected to begin about December 15 with "Happy" White as the spread man.

El Paso Natural Gas Company, Bassett Tower, El Paso, Texas, is laying 805 miles of 30-in. pipe line from Jal, New Mexico, to Topock, Arizona, of which 175 miles have been completed (November 17). Ed Alsup is superintendent of this spread, which is making its headquarters at Willcox, Arizona, at the present time. A number of field lines are being laid in the vicinity of Jal, consisting of 27 miles of 20-in., 14 miles of 8-in., 9 miles of 10-in., and 6 miles of 16 and 20-in. combination. These lines should be completed by the latter part of December at which time this spread will start on the 30-in. Jal-Topock loop. Jack Smith is spread superintendent. A spread working out of Casa Grande, Arizona, under G. George is laying 20 miles of 4, 10, and 16-in. lines near Phoenix. This spread is scheduled to start work on the 30-in. loop in January.

H. C. Price Company, Union National Bank Building, Bartlesville, Oklahoma, is working three spreads on the line of Atlantic Seaboard Corporation and Virginia Gas Transmission Corporation, all of which is 26-in. pipe. W. B. Williams is superintendent of the spread laying 68 miles from Mouth of Seneca to Cleveland, West Virginia. P. O. Rutledge is office manager. The 70 miles from Mouth of Seneca to Strasburg, Virginia, is in charge of Charley Ice. G. A. Harvey is office manager. Laying 68 miles from Strasburg to Rockville, Maryland, is under the supervision of R. K. Shivel. Ray Stokes is office manager.

Anderson Bros. Construction Company, 707 North Drennan Street, Houston, Texas, has been awarded the contract to lay the U. S. section of Interprovincial Pipe Line Company's 1150-mile line from Edmonton to Superior. The section is from Gretna to Superior. It will be of 20-in. pipe.

A. C. Holder Construction Company, 2615 East Admiral Place, Tulsa, Oklahoma, is the contractor for 72.33 miles of 12-in. for Great Lakes Pipe Line Company. This is part of a project that will parallel Great Lakes' two existing lines between Minneapolis, Minn., and Des Moines.

Fish Constructors, Inc., M. and M. Building, Houston, Texas, is acting as agents for Transcontinental Gas Pipe Line Corporation in construction of the line from the Lower Rio Grande Valley to New York City, 2239 miles including main line and laterals. This year 612 miles of pipe is being laid by the following contractors: Morrison Construction Company, Wunderlich and Griffis Pipe Line Construction Company, Midwestern Constructors, Inc., and Williams Brothers Corporation. The Fish organization is building the compressor stations, five of which will be completed this year.

H. L. Gentry Construction Company, 921 East Michigan Avenue, Jackson, Michigan, expects to start construction sometime this month on its portion of the Mid-Valley Pipeline Company job. This contractor's section will consist of 111 miles of 22-in. from Elizabethtown to Hebron, Kentucky. Work began September 6 on 140 miles of 8-in. for The Buckeye Pipe Line Company between Indianapolis, Indiana, and Lima, Ohio.

Morrison Construction Company, P. O. Box 798, Austin, Texas, is laying 180 miles of 30-in. between Bassfield, Mississippi, and Eunice, Louisiana, for Transcontinental Gas Pipe Line Corporation. In Tennessee and Kentucky the contractor is constructing 90 miles of 30-in. for Tennessee Gas Transmission Company.

Wunderlich and Griffis Pipe Construction Company, 745 Riverside Drive, Tulsa, Oklahoma, is nearing completion on the 110 miles of 30-in. it is laying for Transcontinental Gas Pipe Line Corporation between Bassfield, Mississippi, and the Tombigbee River in Alabama. Field headquarters are at Laurel, Mississippi.

Parkhill Truck Company, (stringing contractors), P. O. Box 1856, Tulsa, Oklahoma, has the following jobs in progress:

Texas Gas Transmission Corporation, 80 miles 26-in. in Indiana, Ohio.

Atlantic Seaboard Corporation, 65 miles of 26-in., in the vicinity of Charleston, West Virginia.

Mississippi River Fuel Corporation, 215 miles of 24-in. in Louisiana, Arkansas, and Missouri.

Transcontinental Gas Pipe Line Corporation, 212 miles of 30-in. in Alabama and Georgia.

Salt Lake Pipe Line Company, 190 miles of 8-in., from Salt Lake City to Ogden, Utah.

Tennessee Gas Transmission Company, 90 miles of 26 and 30-in. from Winchester to Lancaster, Kentucky.

Shell Pipe Line Corporation, 190 miles of 10-in. (takeup), between Cushing, Oklahoma, and Emmett, Missouri, and stringing 160 miles of the pipe between Cushing and Elk City, Oklahoma.

Mid-Valley Pipeline Company, 60 miles of 20 and 22-in., from Hebron, Kentucky, to Eaton, Ohio.

Michigan-Wisconsin Pipe Line Company, 30 miles of various diameter pipe in the vicinity of Stoughton and Racine, Wisconsin.

Sheehan Pipe Line Construction Company, 529 National Bank of Tulsa Building, Tulsa, Oklahoma, was delayed in its work in Minnesota for Great Lakes Pipe Line Company because of the steel strike, which stopped delivery of pipe. Construction has been resumed, however. The contractor is laying 52 miles of 12-in. pipe between St. Paul and Fairbault, and 52 miles of 12-in. between Fairbault and Albert Lea. J. W. Brown is superintendent.

The company also is laying 10 miles of 20 and 24-in. near East St. Louis, Illinois, for Mississippi River Fuel Corporation. C. M. Brown is superintendent.

Oman-Fulton-Brodie, P. O. Box 30, Gallatin, Tennessee, are making progress on the 172 miles of 22-in. being laid from Greenbrier to Oak Ridge, Tennessee, for the East Tennessee Gas Company. Spread No. 1 has its headquarters at Cookeville, with Charles E. Fry as superintendent. Spread No. 2 has its field office at Harriman. A. A. Carrigan is superintendent. J. T. Brodie is general superintendent over both spreads.

Eastern Construction Company, 1801 Mercantile Bank Building, Dallas, Texas, was scheduled to get under way in December on the Mid-Valley Pipeline Company job but the steel strikes make it uncertain when pipe deliveries will begin. A total of 222 miles of 22-in. will be laid between Oakland and Clarksville, Tennessee, by this contractor. A main office and two field offices will be established but their exact locations have not been decided. Meanwhile, a single line crossing is being made of the Cumberland River at Clarksville. Fred Byers is the superintendent in charge and J. W. Arthur is office manager.

Smith Contracting Corporation, 1410 Fort Worth National Bank Building, Fort Worth, Texas, expects to complete by December 15 the 168 miles of 8-in. products line it is laying for Salt Lake Pipe Line Company between Salt Lake City and Burley, Idaho. The field office is at Ogden, Utah. Charley Craig is superintendent and Ben Mapes and H. J. McAdams are in the office.

Latex Construction Company, 2707 Ferndale Place, Houston, Texas, has the following construction work under contract:

Mississippi River crossing consisting of two 16-in. gas lines for Tennessee Gas Transmission Company south of Greenville Bridge. W. H. Hayes, superintendent; headquarters, Eudora, Arkansas. Complete except for actual river crossing which will be installed on receipt of pipe.

For Arkansas Louisiana Gas Company, 91 miles of 20-in. gas line from vicinity of Magnolia, Arkansas, to vicinity of Malvern, Arkansas. Approximately 60 miles completed November 10. Remainder of work will be completed by H. L. Leake's spread, which has headquarters at Magnolia, Arkansas. S. B. Harrison is office manager.

For Mid-Valley Pipeline Company, 120 miles of 20-in. crude oil line from Haynesville, Louisiana, to Mississippi River north of Lake Providence, Louisiana. Job is being done with two spreads. One spread is in Bastrop, Louisiana; F. A. Silar, general superintendent; W. A. Briley, spread superintendent; C. V. Oliver, office manager. The other spread is in Eudora, Arkansas; W. H. Hayes, superintendent; M. L. Thompson, assistant superintendent; A. E. Stremmel, office manager. Both spreads began laying pipe November 1.

For Mid-Valley Pipeline Company, 41 miles of 12-in. lateral crude oil pipe line from the vicinity of Delhi, Louisiana, to Lake Providence, Louisiana. E. C. Norris, general superintendent; R. E. Thornton, spread superintendent; R. J. Axsom, office manager; headquarters, Lake Providence, Louisiana. Laying of pipe began November 15.

Mississippi River crossings consisting of two 20-in. crude oil lines for Mid-Valley Pipeline Company north of Lake Providence, Louisiana. J. A. Cantrell, superintendent; J. B. Stoddard, office manager; headquarters, Rolling Fork, Mississippi. Laying of river pipe began November 12.

Red River crossings consisting of two 16-in. gas lines, near Curtis, Louisiana, for Texas Gas Transmission Corporation. H. E. Murphy, superintendent; J. J. Nolan, office manager; headquarters, Bossier City, Louisiana. Job approximately 50 per cent complete (November 10).

Red River crossing consisting of one 20-in. crude oil line, near Benton, Louisiana, for Mid-Valley Pipeline Company. H. E. Murphy, superintendent; J. J. Nolan, office manager; headquarters, Bossier City, Louisiana. Work began early part of November.

Midwestern Constructors, Inc., 105 North Boulder Street, Tulsa, Oklahoma, is more than half finished with the 80 miles of 26-in. it is laying for Texas Gas Transmission Corporation in Jefferson County, Indiana, and Warren County, Ohio. The job has been under way since July 18. R. Carl Stanley is the superintendent in charge. E. E. Haworth is manager of the field office at Aurora, Indiana.

The crossing of the Green River near Slaughters, Kentucky, also is more than half completed. This crossing consists of multiple 20-in. lines. The field office is at Rumsey, Kentucky. Leroy Jackson is superintendent and Bill Daniels office manager.

Section 4 of the Transcontinental Gas Pipe Line Corporation job has been completed and this crew is now working on Section 5. The two sections together consist of 216 miles of 30-in. extending from Demopolis, Alabama, to Newnan, Georgia. M. T. "Bill" Wilhite is in charge of the work. There are two field offices, one at Alexander City, Alabama, with A. T. Tolbert as office manager, and the other at Roanoke, Alabama, with Cash Carrell the office manager.

Canadian Bechtel Company, associated with **Fred Mannix** of Calgary, has been awarded a contract to construct 450 miles of 20-in. line for the Interprovincial Pipe Line Company. This section will be between Edmonton and Regina, and is a part of the 1150-mile line being laid from Edmonton, Alberta, Canada, to Superior, Wisconsin.

Bechtel-Price-Conyes, 220 Bush Street, San Francisco, California, is working north of Gilroy, California, and also out of Topock, Arizona, on Pacific Gas and Electric Company's 34-in. 506-mile line from Topock to Milpitas, California. The field office near Gilroy has Steve Valline as its manager. R. L. Bowman is superintending the construction work.

Williams Brothers Corporation, National Bank of Tulsa Building, Tulsa, Oklahoma, has recently been awarded a contract to lay 340 miles of 16-in. line for Interprovincial Pipe Line Company of Edmonton, Alberta, Canada. The section is between Regina and Gretna and is a part of Interprovincial's 1150-mile line from Edmonton to Superior.

This contractor also is laying 166 miles of 26-in. for Texas Gas Transmission Corporation from Slaughters, Kentucky, through Brandenburg to the Ohio River. On the Transcontinental Gas Pipe Line Corporation project 112 miles are being laid from Newnan to Danielsville, Georgia. For Great Lakes Pipe Line Company, 19.6 miles are being laid as a part of a loop between Minneapolis and Des Moines, and a crossing made of the Mississippi River at South St. Paul.

Trojan Construction Company, P. O. Box 4427, Oklahoma City, Oklahoma, is making good progress on the Shell Pipe Line Corporation job. Between Cushing, Oklahoma, and Emmett, Missouri, 190 miles of 10-in. are being taken up. The pipe is being reconditioned in a central yard just outside Cushing and re-laid from that point to the Elk City field, a distance of 160 miles. Maurice Crawford is in charge of the takeup and Swede Tillotson the laying.

J. L. Cox and Son, Raytown, Missouri, (stringing contractors) have contracted to string pipe for the Great Lakes Pipe Line Company as follows: Invergrove to Fairbault, Minnesota, 51.43 miles, Melvin Thompson foreman; Medford to Albert Lea, Minnesota, 52.18 miles, Lionel Pugh foreman, and Radcliff to Des Moines, Iowa, 64.63 miles, Fred Osterman foreman. All is 12-in. pipe.

Bishop and Lock Construction Company, 503 Magnolia Building, Dallas, Texas, is laying four lines across the Brazos River at Kopperl, Texas, for Magnolia Pipe Line Company. The lines will be beneath the new Whitney Dam now under construction. There are two 8-in. and two 10-in. lines each two miles long. The lines are being cased. Barney Hall is in charge of the work.

MARINE OPERATIONS

Lloyd's Survey Shows More Tanker Construction

Continuation of the steady increase in the building of merchant vessels throughout the world is indicated by returns listed in the third quarter report of Lloyd's Register of Shipping. Since the beginning of this year, there has been an increase of nearly 500,000 gross tons in the volume of merchant vessels under construction. At the beginning of January, the volume of shipping underway aggregated 4,140,000 gross tons, which rose to 4,355,000 tons at the end of March, then to 4,446,000 at the end of June, and finally to more than 4,607,700 tons by October 1.

World shipyards report there are 1,908,167 tons of steam and motor tankers combined under construction at the present time, as compared to 1,667,000 at the end of June.

A substantial increase in the tonnage of motor tankers, of 1000 gross tons and over, is shown by Lloyd's survey. At the end of March, the world total of motor tankers underway was 958,013 tons; at the end of June the figure had risen to 1,014,879, and is now approximately 1,178,492 tons. Of current motor tanker construction, British yards report 704,022 tons, as against 611,948 tons at the end of June. Sweden's total at the end of September was 146,500 compared with 122,600 tons in the previous quarter. Other nations registering an increase include the Netherlands and Denmark, while Norway and Belgium report a decline in motor tanker construction activity. Those remaining unchanged include France, Spain, Italy, and Portugal.

Another 30,000-dwt Tanker Launched

Another giant tanker was launched by Welding Shipyard, Inc., at Sewalls Point, Norfolk, for Oceanic Tankships, S.A., of National Bulk Carriers, Inc. where Mrs. J. J. Winterbottom wife of the assistant general manager, marine department, Standard Oil Company (New Jersey), christened the 30,000 dwt tanker the *Bulkstar*. The fourth in a series of five supertankers ordered by the owners, *Bulkstar* is scheduled to be delivered in December when she will join the fleet of the largest tankers in the world, including the *Bulkoil*, *Bulkpetrol*, and *Bulkoceanic* already in active service. *Bulkstar* will have a volumetric capacity of more than 255,000 bbl of oil and a designed speed of 18 knots. General Electric geared turbine propulsion equipment, rated 17,600 shp maximum, gives a loaded speed of about 17.5 knots, and three G-E 450-hp turbines power the main cargo pumps. Dimensions include: Length bp 615 ft, beam moulded 84 ft, and loaded draft of 33 ft 5⅛ in.

Tankers Delivered to Norwegian Owners

Harland and Wolff, Ltd., of Belfast have completed the motor tanker *Vikingen* for the Tanker Corporation of Panama City. The latest of a series of tankers ordered by Norwegian owners to be completed at the yard, the 12,000-dwt *Vikingen* is constructed on the combined longitudinal and transverse system of framing, has two main longitudinal bulkheads with transverse bulkheads forming 24 main cargo oil tanks, and is of the usual tanker design with propelling machinery aft. Dimensions are: Length bp 460 ft, breadth moulded 59 ft, and depth moulded 34 ft 10 in.

At the same time, Sir James Laing and Sons, Ltd. of Sunderland delivered the motor tanker *Steingrim Stange* to Skibs, A/S Arnstein of Oslo. The second of two on order, *Steingrim Stange* is mainly of all-welded construction with deadweight of about 15,400 tons on a draft of 29 ft.

After successful trials, the motor tanker *Gunnar Brovig* of 15,470 dwt was delivered to T. H. Brovig concern, Farsund of Oresundsvarvet, Landskrona. Built to Lloyd's highest class, *Gunnar Brovig* has a well raked stem, cruiser stern and two continuous longitudinal bulkheads on either side of the center tanks dividing them into nine center and ten side tanks.

USMC Creates Two New Bureaus in Reorganizing

Charles D. Marshall, general manager of the U. S. Maritime Commission, has announced two major agency bureau changes as the first step in reorganizing the commission since Maj. Gen. Philip B. Fleming, USA, USMC chairman, was granted full administrative authority under the Reorganization Act. Under the change, the Bureau of Management and the Bureau of Marine Operations have been abolished and replaced by two others, the Bureau of General Service and Bureau of Vessel Custody. Harold E. Steffes, formerly a division head, became chief of the new Bureau of General Service, while Ernest W. Gorman, former division head, took over as head of the Bureau of Vessel Custody. Other personnel shifts include Frank E. Hickey, formerly chief of the Bureau of Marine Operations, who now heads the division of purchases and sales in the General Service Bureau. Ward B. Freeman, formerly chief of the Bureau of Management, is now operations examiner in the Bureau of Government Aids; Martin Goodman remains as chief of vessel operations.

SNAME Recognizes Member Accomplishments

At the annual meeting of The Society of Naval Architects and Marine Engineers the following awards were made to members for notable accomplishments in the industry.

The eleventh award of "The David W. Taylor Medal" for notable achievement in naval architecture was made to George G. Sharp, naval architect, of New York City and a vice president of the Society.

"The Captain Joseph H. Linnard Prize" was presented to George W. Kessler, application engineer, The Babcock and Wilcox Company, New York City, for his paper, "Procedures and Influencing Factors in the Design of Marine Boilers," presented at the annual meeting of the Society in 1948.

"The President's Award" for 1949 went to Harold G. Acker, engineer, central technical department, Bethlehem Steel Company, Shipbuilding Division, Quincy, Massachusetts, for his paper, "Highlights of Welded Ship Research," which was selected as the best paper presented before a meeting of a local section during the year 1948-49.

"The Junior Paper Award" for 1949 was given to Charles P. Furney, Jr., recently graduated from the United States Merchant Marine Academy, for his paper, "Proposed Automatic Tanker Loading," presented before the New York Metropolitan Section.

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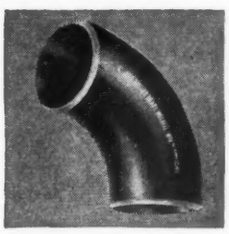

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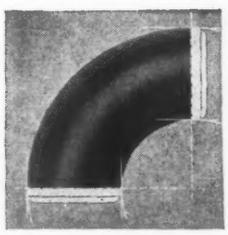
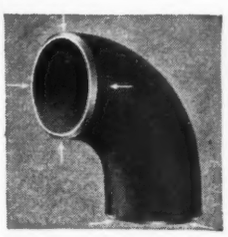


2 Sized end-tangents



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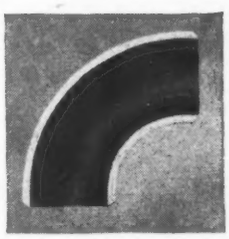

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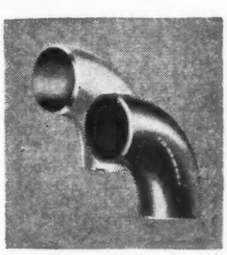

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PETROLEUM PROFILE

MICHAEL HALPERN

Vice President and Director,

The Texas Company

A TYPICAL example of the Home Town Boy Who Made Good in The Home Town is Michael (Mike) Halpern, now vice president of the refining department of The Texas Company, and a director of that company since early 1946. Born in New York City, he graduated with a Civil Engineering degree from New York University shortly before the beginning of the U. S. part in World War I. He began work with The Texas Company in June of 1916, as assistant civil engineer at Bayonne, New Jersey, and a year later became civil engineer for that plant.

Then began a steady and continuous march up the ladder. The company's Providence terminal needed an assistant superintendent; Mike Halpern received the nod, and carried on there, gaining a great deal of invaluable experience. He was selected to manage the Delaware River terminal in 1923. In October, 1925 he was moved into the 'main stream' of manufacturing, by being made superintendent of the Port Neches, Texas refinery, a plant devoted largely to the manufacture of asphalts, road oils, and similar products, and working in conjunction with the main Port Arthur refinery situated a few miles away. People acquainted with the area remember the vapors rising from plant process water, transferred from one plant to the other via a large open canal across the flat marsh country between the two plants.

Within a year he moved over to the headquarters in Houston as operations auditor, and after two years in that strategic position he went to the main Port Arthur refinery as second assistant superintendent. In two years he was needed in the home office, New York City, as assistant refining department manager and came back to his boyhood home. In New York he served also as research director until October, 1933.

In less than four years he was promoted further to the refining department managership, then general manager of refining in 1938. A two-year 'voyage' in this position, and Halpern was selected as vice president in charge of the refining department. In this most important position he is still in command of all refining activities. In addition to these high responsibilities he was made a director of the company, on February 8, 1946 and thus assumed a still more important role in directing the company's far-flung operations in refining.

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Where Our Industry Stands Today*

T. E. SWIGART†

Petroleum Demand

We, who are giving our lives to the American petroleum industry, are indeed fortunate. Our industry has always been a vigorous one and has seldom suffered for lack of demand. From the turn of the century, it has grown from a 175,000 bbl-per-day baby to a 5,500,000-bbl giant. Over the past 20 years, United States consumption has increased every year but seven. Even in 1949, with a business recession predicted by some and a poor start because of an extra warm winter, it is estimated that domestic consumption will increase by more than 5 per cent to probably 6,000,000 bbl per day, or possibly a little above.

Let us first examine some of the elements of petroleum demand. Gasoline is still king of products, and until the point of motor vehicle saturation is reached, gasoline demand, and probably total demand in this country, will continue to grow. The demand for distillate fuel has so increased in the past 15 years, however, that this product almost rivals gasoline in importance. In 1934, intermediate or distillate cuts amounted to 10.6 per cent of petroleum processed in the United States, but in 1948 they represented 19.3 per cent.

Residual fuel is the product worrying refiners today. It feels the effects of competition of other fuels more quickly perhaps than any other petroleum product. Residual is still the desired fuel for bunkers, but one of its other great markets, railroad fuel, is fast disappearing as a result of the railroad dieselization program.

In 1948 railroads used 257,000 bbl per day of residual fuel and 85,000 bbl per day of diesel, plus large quantities of coal. If, as has been estimated by one economist, one-half of the remaining oil burning locomotives and 40 per cent of the coal burning locomotives are replaced with diesels by 1955, the railroad diesel fuel demand will increase to 185,000 bbl per day, but residual fuel oil consumption will be reduced by 125,000 bbl per day and coal by 35,000,000 tons per year. The net effect is the loss of an over-all market to the oil industry of 29,000 bbl per day. Though this is a loss of oil markets, it is a commendable result of technological progress in the conversion of oil fuel to mechanical energy.

Residual fuel comes into direct competition with coal and natural gas in other fields. Just how far refiners can go in replacing their lost fuel markets by pricing themselves into other markets is not clear. All industrial plants are not equipped to make immediate conversions from gas to oil or coal to oil, and this limits the short term fluctuations in fuel demand. On the whole, competition in the field is extremely keen as has been demonstrated in recent weeks by a precipitant drop in fuel oil prices from $3 in New York Harbor to $2, at which level oil is cheaper than coal. The coal people recognized this and cut coal prices from 15 to 40 cents per ton.

Industry economists are forecasting a gradual drop in residual fuel oil demand. Oil refiners are therefore fully alert to this situation and recognize that they must meet this by converting a greater share of residual cut of petroleum into other products or by selling their fuel on a price basis.

We have been hearing a lot these past few years about chemicals from petroleum and the rapid strides that have been made in the petrochemical industry. In 1948 this industry consumed approximately 3¼ billion pounds of petroleum hydrocarbons worth an average of 1⅓ cents per pound. These materials were mostly methane, ethane, propane and propylene, butanes and butylenes, and toluene and xylenes. These raw materials were converted into approximately 5 billion pounds of primary chemicals, alcohols, ammonia, styrene, etc. valued at over $400,000,000. Eventually these primary chemicals showed up in synthetic rubber, anti-freeze, plastics, paints, detergents, and similar products, which you all recognize, and the value of which was more than a billion dollars.

Despite these staggering figures, the petrochemical industry only consumed 40,000 or 50,000 bbl per day of products from petroleum and natural gas, and volume-wise it is of small significance in the total petroleum demand in the United States. During the past 20 years, it is said that the petrochemical industry has doubled every three years. No one knows whether it will continue this rate of growth or not. One authority stated that perhaps the industry's growth in the next decade will only be "amazing" instead of "stupendous." Be that as it may, the future of this industry appears bright in itself, but to put it in its true perspective, it must be said that the industry, although fired with ideas and enthusiasm, regards the oil industry as an ample source for its raw materials, but the oil industry cannot regard it as an important outlet for its products.

Another factor that has affected petroleum consumption in recent years is the aviation industry. The aviation fuel demand has grown from about 4000 bbl per day in 1934 to almost 120,000 bbl per day in 1948. Although this is small in comparison with the United States total gasoline consumption, it is in itself an important quantity. Continued and healthy growth of this demand is expected. Jet fuels stir the imagination, but volume-wise are still of no importance—probably of the order of 7500 to 10,000 bbl per day.

The following tabulation, prepared by Arthur D. Stewart[1] of Socony Vacuum records the growth in United States and foreign consumption since the beginning of the recent war and estimates demand for the coming five years:

	U.S. Demand		Foreign Demand		Total World Demand Excluding USSR	
Year	B/D	% Change	B/D	% Change	B/D	% Change
1940	3,625*	7.5	1,774*	(2.4)	5,399*	4.0
1941	4,071	12.3	1,577	(11.1)	5,648	4.6
1942	3,972	(2.4)	1,381	(12.4)	5,353	(5.2)
1943	4,168	4.9	1,744	26.3	5,912	10.4
1944	4,562	9.5	2,088	19.7	6,650	12.5
1945	4,857	6.5	2,083	(0.2)	6,940	4.4
1946	4,912	1.1	2,153	3.4	7,065	1.8
1947	5,452	11.0	2,570	19.4	8,022	13.5
1948	5,761	5.7	3,061	19.1	8,822	10.0
1949	6,200[1]	7.6	3,160[1]	3.2	9,360[1]	6.1
1950	6,450	4.0	3,381	7.0	9,831	5.0
1951	6,650	3.1	3,618	7.0	10,268	4.4
1952	6,850	3.0	3,871	7.0	10,721	4.4
1953	7,050	2.9	4,142	7.0	11,192	4.4

*Bureau of Mines through 1948.
[1]Stewart, Arthur D. "World Outlook . . . Petroleum Supply and Demand," *World Petroleum*, January, 1949.

*Presented at the American Petroleum Institute, Spring meeting of the Mid-Continent District, Tulsa, Oklahoma, March 23-24-25, 1949.

†T. E. Swigart is president Shell Pipe Line Corporation, Houston, Texas.

Supply

Now let us examine the supply situation. One of the most important facts brought out by a study of petroleum economics is the effect of shifting sources of supply. Until now, the United States has been the greatest consumer of petroleum in the world and has, in effect, produced all of the oil that it needed with some left over for export. The development of large scale production in Venezuela relieved the United States of some export demand, but now rapidly increasing production in the Middle East, backed by tremendous reserves, threatens to take an important part of the European market from both the United States and Venezuela. The net effect of this on our domestic industry is the loss of some foreign outlets, but if we gear ourselves chiefly to take care of our domestic requirements, we will still have a vigorous industry and one that promises growth from year to year.

Although this is an old story, it is such a true one that it justifies retelling. Just what has happened to the world petroleum supply situation? The old law of economics has simply worked again. Unexpected post-war demand led to a supply shortage, and this to a higher price for oil. Higher prices stimulated wildcatting, and wildcatting, in turn, yielded results. Quite apart from developments outside our borders, we are again substantially self-sufficient here at home. The Permian Basin of Texas is thriving with activity and seems to be yielding new fields by the day. New fields are being found in practically all other parts of Texas, in New Mexico, Louisiana, and Kansas. Oklahoma, which from time to time over the past 20 years has been reported as on the down-grade, has experienced an important revival in production. The Anadarko Basin has proved its worth, and the state is now looking with considerable hope to an entirely new province—namely, Western Oklahoma.

The tidelands area of the Gulf Coast is recognized as one of tremendous potentialities. The offshore areas of Louisiana have already been shot —some of them several times—by the companies. Operations in the Texas tidelands have been slower because of the provisions of the state law limiting exploration to areas that have been leased by the state. But 22 wells are drilling in the offshore areas of Louisiana and Texas, and 10 oil and gas fields have already been discovered. Carsey[2] has shown that the offshore

[2]Carsey, J. Ben, "Basic Geology of the Gulf Coast Area and the Continental Shelf," *Oil and Gas Journal*, June 24, 1948.

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areas of these states within economic reach of development might contain as much as 4 or 5 billion barrels of reserves. Such amounts would represent additions of from 15 to 20 per cent to the present United States total. The amount of daily production that may be obtained from the tidelands will depend on various developments, including demand, but it is almost certain that the tidelands fields will force their way into the production picture of the United States, and that they will be an important factor in time of national emergency.

The Rocky Mountains have been the scene of active operations for the past two or three years. Because of the sparseness of population, limited industrial development, remoteness from centers of heavy consumption, and the existence of only one relatively small pipe line from the area, development has not been pushed to the same extent as other potentially productive areas of the United States. But stimulated by petroleum shortages and better prices over the past two or three years, the industry has shown new interest with the result that 1271 producing wells were completed in the mountain states in 1948. A total of 228 wildcats were drilled, of which 41 produced oil or gas. Production increased from 136,931 bbl per day in 1945, the last war year, to 222,994 in 1948. In addition, an estimated 40,000 bbl per day of "black oil" production was shut in as of December 31, 1948, for lack of market. Meanwhile, the area has lost some of its previous markets in the Canadian Prairie Provinces to local production there, but it has also expanded its markets by pushing its products into the Pacific Northwest, in turn easing the demand on California. Sooner or later, if potential production continues to increase, the Rocky Mountains will have to seek an outlet by large pipe line to some area of high consumption such as the United States Middle West or the Pacific Coast.

California is another producing province which has been the subject of dire predictions, but the state's oil fields have a peculiar habit of tenaciously holding on, and their sustained production, together with the effects of large importations of natural gas on the state's fuel requirements, have eased the supply situation there.

Oil in Canada

It goes without saying that domestic reserves are by far the most important to the United States, not only because of their accessibility to existing transportation systems and refineries, but because they lie within our own borders, and thus provide the greatest insurance in times of national peril. Also important would be reserves in our neighboring countries, Canada and Mexico.

The prairie provinces of Canada comprise a large, sedimentary basin which, according to Pogue,[3] is one-third the size of the prospective oil territory in the United States. For such reasons as inaccessibility to large markets, slow population growth, and other factors, oil development in this part of Canada has been slow although potentialities of the area from the United States border to the Artic Circle have long been recognized by geologists. Turner Valley, of course, was a great field, but the discovery of the Leduc Field in 1947 and Redwater in 1948 gave tremendous impetus to the development of the area, and it is now teeming with geophysical crews and exploration activity.

One problem always confronts the oil industry in remote provinces of this kind—namely, the development of enough daily production, backed by large enough reserves, to justify an expenditure for a major pipe line to a large market. The local market in Alberta, Saskatchewan, and Manitoba is of the order of 60,000 bbl per day. In the past a substantial part of this requirement has been supplied by the United States, but probably by the end of the year, this part of Canada will be able to take care of itself. Eventually it is believed that this province will produce as much oil as all Canada will consume. To make this oil competitive by present day standards, a large crude pipe would have to be built to the Lakes or to the Pacific coast. In other words, a line of, say, 100,000-bbl-per-day capacity or more should be considered, and such a line should be backed by reserves available to it of 400 or 500 million barrels.

Bridging the gap between the 60,000 bbl per day local requirements and the additional 100,000 bbl per day of pipe line requirements would ordinarily pose a problem, but the momentum set up by wildcatters may well lead to the development of the necessary production and reserves at a fairly early date. In any event, the province is extremely promising, and this is very reassuring to us because of its location in the heart of the North American continent and our knowledge of the traditionally warm friendship between the United States and Canada.

Oil in Mexico

Mexico, with smaller petroliferous provinces, is almost as important to hemispheric defense as Canada. Here is a country, which at one time produced 25 per cent of the world's supply of petroleum, but which, after the exploitation of its original Golden Lane fields and the expropriation of privately owned properties, dropped to a position of relatively small importance in the world oil picture. Mexico's present production of 164,310 bbl per day is scarcely enough to meet her own domestic requirements. It is the consensus of informed opinion that much additional oil could be found in Mexico if the governmental climate were favorable to private enterprise. But with the restrictions of Mexican law, private capital, practically speaking is barred, and exploration and development have been comparatively slow. This is a matter of great economic concern to Mexico and of political concern both to the United States and Mexico. The common welfare and the friendship of the two countries assures that in case of aggression their oil resources would be pooled for the common defense. Thus, the existence of a thriving petroleum industry in Mexico is greatly to be desired.

Middle East Oil

It is not the purpose of this paper to undertake a discussion of oil reserves and potentialties of the Middle East except as they may bear on the American petroleum industry. It is well known that tremendous reserves have been found in Iran, Iraq, Kuwait, Saudi Arabia. De Golyer places these reserves at as much as 32,621,000,000[4] bbl, or 1.16 times the proved reserves of the United States. Other writers have made much more extravagant claims. But regardless of the exact figure, reserves are so vast that they could supply world requirements for many years. As mentioned previously, it now seems quite certain that Middle East oil, because of its cost advantages, will largely take over European markets—thus backing out oil from the Western Hemisphere. Furthermore, events of the past year have proved that this oil, despite its unfavorable transportation cost differential, will stand ready to supply any deficiencies in the United States. The conclusion seems justified that, barring war, which could cost the loss of Middle East supply, or the cutting off of these supplies by interruption of transportation, there will be no shortage of petroleum in the United States or the world in the foreseeable future.

The domestic industry, which 12 months ago was allocating supply and setting up committees to alleviate shortages, has been startled to find it-

[3]Pogue, Joseph E., *Oil in Canada*, published by The Chase National Bank, New York.

[4]De Golyer, E., "Global Oil Reserve," *Oil and Gas Journal*, December 30, 1948.

self looking for business. But anyone who has been in the oil business for as long as a year knows better than to expect demand and supply to be in balance. History shows that we are always in a cycle of long supply or short supply despite the fact that demand has continued to increase. Looking back over the period of my own connection with the industry, I can realize that most of the time we have been in an economy of ample supply, and therefore, the present condition may be considered normal. This is not new. It is not startling. The industry has been built on adequacy of supply and it has grown and prospered in that atmosphere.

Synthetic Industry

Much has been heard of the possibility of developing a synthetic industry within our own borders, and the time may come when such an industry will exist, although I doubt if that time will arrive very soon. The nation has large deposits of oil shale and coal, which, if economics favor, would doubtless become important substitutes for liquid petroleum production. This presents another one of these problems that is partly technologic and partly economic. If the demand, and therefore the price, justified the development of a synthetic industry, I am convinced that it would spring into being within a very short time. The history of synthetic rubber manufacture is example enough of the force and determination and "know-how" of American industry in times of need. But as the situation now stands, we are going to be reliant upon liquid petroleum reserves for an indefinite period. Meanwhile, economics probably will not support development of a large scale synthetic industry. If war should come and cut off our outside supplies of liquid petroleum at a time we were partially reliant on them, there could be an awkward interval pending the creation of a large scale synthetic industry. To minimize this, research and pilot plant operations must be pushed aggressively. This will insure the least loss of time and motion in establishing a synthetic industry in case of national emergency.

Earnings and Capital Requirements

Some critics of the industry have raised an awful howl about the industry's profits. It is true that recent profits in dollars have looked large, but when the dollar is corrected for its purchasing power—as it must be if this question is looked at in proper perspective, these profits at once shrink by about 50 per cent.

Other factors also have an important bearing on earnings, and we cannot allow this question to be discussed in terms of half truths or quarter truths. For example, one reason for today's high profits is the sale of oil from underground reserves which were found in the days of much lower costs. To replace this oil for tomorrow is costing very much more. Still it must be replaced. Also new plants, which have to be built today, cost twice as much as those which they replace.

The oil industry, because of the hazards of exploration and production and the exceedingly rapid technological advances and early obsolescence of equipment, is a tremendous consumer of capital. Pogue[5] has shown that in 1947 the industry needed $2,903,000,000 of new capital. Admittedly, this large capital investment may be a high point in the historical record of the industry, yet each year expenditures of near this order seem to have to be financed. Now, where does the money come from? There are only three money pools from which funds can be drawn. The first and easiest source is that provided by the annual reserves for depreciation and depletion. This is not enough to meet extraordinary capital needs, and in fact it will no longer take care of normal needs because depreciation represents the return of investments made at much lower costs. Second is the pool of net profits. If this is drawn on too heavily, the investor (you and I) has to suffer through little or no return on his money. The Government is always encouraging the use of equity capital, but it is not far from the truth to say that parties putting their savings into equity stocks are the forgotten race. For example, of the $2,903,000,000 of new capital required in 1947, 42 per cent came out of earnings. This money, plus the 32 per cent that accrued from depreciations and depletion reserves—the industry's own money—represented 74 per cent of the new capital needed in 1947.

The third and last source of new capital is from borrowing. In 1947, the industry borrowed $426,000,000 and paid back $197,000,000 on its debt. Everyone knows that this borrowing cannot go on indefinitely; after all, the industry must pay back borrowed money, and over the long term, it must pay back as much as it borrows.

It should be clear that more realism should be directed to the problem of oil industry financing than is possible when viewed through the eyes of some unfriendly politicians. High income tax rates on individuals, the double taxation of dividends, the constant rumblings of governmental displeasure over earnings and dividends and of the diversion of net earnings to capital replacements, do not create a favorable atmosphere for the saving individual who otherwise might be willing to risk his money in business ventures, and particularly speculative ventures such as the oil business.

Quoting from Pogue:[5]

"It can be stated with assurance that it was the magnitude of capital formation in 1947, and again in 1948, which has converted the petroleum situation from one of scarcity into one of abundance. What could be more important?"

We are now well into the year 1949, and although it is too early for first quarter earnings, it is reasonably certain that profits for the year will be lower. Whether capital requirements will be less remains to be seen. There cannot be much let up in the search for oil because our tremendous national consumption requires constant replacement of depleted reserves. We don't claim the industry is hard up, but we don't admit either that it is rolling in wealth. It is a big industry that requires big money to keep it going, and it does not owe anybody an apology for having managed its financial affairs soundly and well.

Before closing, I should like to mention one further obligation of the industry. It has the job of informing the public of the real facts concerning the oil industry—or, if you please, the public's oil supply. Oil has rooted itself so irrevocably in the national economy that the time has long since passed when the industry can or would desire to consider its affairs as only its own business. With this in mind, the API set up a Public Relations Committee which is making it its business to inform the public of the industry's problems. These are not always pictured in their true light by others, for others are not always friendly, and occasionally they even distort the facts for some self-interest. But the industry has nothing to hide, and it expects to be in position to meet all needs in volume and quality—at prices which will aid and not hinder the march of progress in America.

* * *

[5]Pogue, Joseph E., *The Function of "Profits" in the Petroleum Industry*, published by The Chase National Bank, New York, December, 1948.

Designed to keep pace with the rapid modernization of American railroads, the world's largest railroad crane has been put into service by a Michigan firm. Diesel-powered, it has a lifting capacity of 250 tons.

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NEWS

Markham to Head API

Baird H. Markham was chosen president of the American Petroleum Institute at its annual meeting in Chicago, Illinois, recently. Markham is a native of Decatur, Texas, and since 1933 has been chairman of the American Petroleum Industries Committee, a tax affiliate of the API. A graduate of Texas Christian University, Markham was comptroller of Continental Oil Company before taking the petroleum industries committee post. Markham succeeds William R. Boyd, Jr., who retired.

Brazil Sees Gains in Oil

When visiting in Dallas, Texas, General Joao Carlos Barreto of Brazil told reporters that his country had advanced from zero to 7000 bbl of oil daily in 8 years.

The head of the Brazilian government oil industry told of the 45,000-bbl thermo-cracking United States-designed refinery that will be built soon in Santos, and a large pipe line from Sao Paulo to Santos.

General Barreto went to Rifle, Colorado, to see the latest development in U. S. experiments in producing oil from low-grade oil shales.

A permanent representative in New York will be named to act as a co-ordinator for all the U. S. firms aiding in Brazil's petroleum industry.

Peru May Grant Concessions

Osvaldo Buonanni, financial editor of *La Prensa* in Lima, Peru, has predicted that his country will make new concessions to U. S. oil interests. He stated that legislation will be passed that will reverse the former treatment of American investors.

Hereafter, he stated, foreign capital will be able to operate on a "decent" royalty, without interference. He estimated the royalty his government is expected to ask of oil companies to be about "15 per cent."

Phillips Elects Attorney

The board of directors of Phillips Petroleum Company has elected Harry D. Turner to the office of general attorney, succeeding R. B. F. Hummer, deceased. Turner received his law degree from the University of Oklahoma in 1931. From 1931 until 1937, he was in the general practice of law in Oklahoma City. On the latter date he became a member of the staff of the Oklahoma City division of the legal department in Phillips Petroleum Company and in 1939 was made chief attorney of that division.

Texas Oil Allowables Are Cut for December

A 218,357-bbl daily cut in Texas oil allowances in December has been set by the Texas Railroad Commission. This cut makes the Legislature's revenue problem so acute that Governor Allan Shivers has announced that he will call a special session in January, 1950. This reduction will set production at about 2,094,870 bbl daily in December.

The cut has been attributed to the mild winter weather, which is making a sharp decline in demand. Ernest O. Thompson, commissioner, estimated actual production in December will run 7 per cent below permissible output. He stated, "The economists predicted greater needs than demand proved. The cut was necessary because of a superabundance of stocks."

In Louisiana, the Department of Conservation has set a record allowable of 563,157 bbl of daily oil production in the state during December. The gross figure, expected to yield net oil production of 535,657 bbl, is the highest it has ever been.

Heads ECA in Paris

George S. Walden, former chairman of the board and chief executive officer of the Standard-Vacuum Oil Company, assumed duties as head of the petroleum unit in the office of the Special Representative in Paris, the Economic Cooperation Administration announced. Walden was with Standard-Vacuum from 1934 to 1946 when he retired.

Before joining Standard-Vacuum, Walden was with other oil companies for 25 years. He occupied several executive posts in which he was responsible for foreign trade operations.

Railroads to Lower Oil Rates

The railroads are now reducing their service rates in an attempt to gain back the tonnage that has been diverted to trucks and barges. Lubricating oils, greases, petrolatums and some other products, charged higher than gasoline, kerosine and fuel oil, are receiving nation-wide attention by the railroads.

When officials of the railroads met to reduce tariffs, however, they couldn't agree, with the result that reductions will not be made everywhere in the same manner or in the same degree. The railroads are aware of the possibility of some dissatisfaction, but they propose to make all reductions promptly and later to make whatever changes are necessary. The eastern railroads have assured shippers that every effort will be made to have the changes made by the first of the year.

Sir John Henry Dacres Cunningham

Cunningham Chairman Of Iraq Petroleum

Admiral of the Fleet Sir John Henry Dacres Cunningham, GCB, MVO, MIEE, has been elected chairman of the Iraq Petroleum Company and associated companies on the recent retirement of Sir Francis Humphrys, GCMG, GCVO, KBE, who had served as chairman of the Iraq Petroleum Company for eight years.

In 1924 he was promoted to captain and lectured on logistics to the Senior Officers' War Course from 1924 to 1927. In this capacity his early interest in oil was intensified by his study of world oil supply problems and his appointment in 1930 as Deputy Director of Plans at the Admiralty (Director 1931-1932) and member of the Middle East Sub-Committee of the Imperial Defense brought him into intimate contact with Middle East oil developments in the crucial period preceding the construction of the Iraq-Mediterranean pipe lines.

Sohio Consolidates Divisions

Sohio Petroleum Company has consolidated its eastern and western divisions, with headquarters in Oklahoma City. The new division consists of Michigan, the tri-state Illinois Basin, western Kansas, Oklahoma, and the Rocky mountain area. The Abilene and Midland districts, formerly in the western division, have been assigned to the southern division.

Blanket Oil Lease Approved

The Interior Department has announced approval of a blanket oil lease and operating contract for waterflooding the 22,000-acre North Burbank unit on the Osage Indian reservation in Oklahoma. The approval came after almost three years of negotiations between representatives of the department, the Bureau of Indian Affairs, the tribal council and the 14 corporations and 6 individuals owning leasehold interests in the unit.

NEWS

Metallurgists' Income Best, National Survey Reports

Metallurgy is the highest paid of the engineering professions. This fact was established as a result of a recent national survey conducted by the American Society for Metals from its National headquarters in Cleveland, Ohio. The survey, first of its kind ever made, also classified the professional metallurgist as to his title, class of work, responsibility over others, distribution of time, products made by his company, as well as salary bracket at different periods of employment.

This occupational analysis of the metallurgical profession, conducted by the metalworking industry's basic society, establishes for the first time a separately defined status for the metallurgist. Previous statistics were with mining engineers or other groups.

Makes Scholarship Award

The Socony-Vacuum Oil Company, Inc., has awarded $2000 to Georgia Institute of Technology, Atlanta, to establish a fellowship for research in chemical engineering from September 15, 1949, to June 30, 1950. This makes 19 fellowships for Socony.

Proposes Canadian-U. S. Exchange of Crude Oil Supplies

While no exports of Canadian crude oil into the United States are contemplated at present as a result of the Edmonton-Superior pipe line, the time will come when exchanges of crude oil will provide an advantageous arrangement for both Canada and the United States, H. H. Hewetson, chairman of the board of Imperial Oil Ltd., predicted. He was speaking to the Rocky Mountain Oil and Gas Association in Denver, Colorado.

For example, Hewetson said, U. S. areas near the new pipe line development would have an economical source of crude oil, while existing channels of supply could continue to deliver crude oil and products from the United States to other parts of Canada.

Hewetson said he felt few people realized that a barrel of Canadian crude delivered to a western U. S. refinery, if balanced by a barrel of U. S. crude delivered to a refinery on the east coast of Canada, had the same net effect as a barrel produced and consumed in Canada. Exchanges of this sort would rule out unnecessary transportation charges.

Federated Buys Stock

Federated Petroleums, Ltd., of Calgary has purchased Imperial Oil's entire interest in Foothills Oil and Gas Company, Ltd., and in Lowery Petroleums, Ltd., Imperial announced.

Imperial's interest in Foothills amounted to 1,181,805 shares, representing 80.8 per cent of the outstanding stock. The sale of Foothills carried with it the controlling interest in Southwest Petroleums, its subsidiary, as Foothills owned 370,506 shares or 62.7 per cent of the issued stock. Imperial's interest in Lowery was 770,005 shares, representing 77 per cent of the issued stock.

Safety Awards to Ohio Oil

The Ohio Oil Company was awarded two first prizes and a certificate in the National Safety Council's safety contest for the year ending June 30, 1949. The awards were received by J. C. Askam, safety manager, at the National Safety Congress, Chicago.

First prizes were won by the Ohio's refining division and wholesale marketing department in the Group B petroleum section of the contest. The pipe line department was awarded a certificate in Group A of the crude oil pipe line section in recognition of outstanding achievement in reducing the frequency of disabling injuries.

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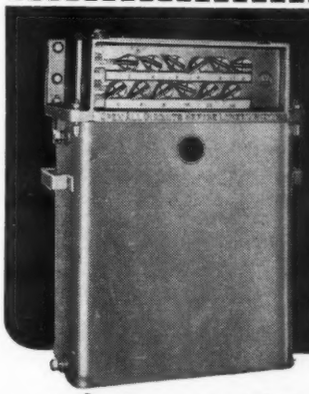

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Tide Water Reports New Crude Oil Supply

William F. Humphrey, president of Tide Water Associated Oil Company, reports execution of a contract with Richfield Oil Corporation for a supply of crude oil for five years beginning January 1, 1950. The oil will be bought at posted field market prices and in volumes that, together with the company's own production and other purchases, will meet its Pacific Coast refining requirements of crude oil. The arrangement with Richfield was negotiated to take the place of the crude oil purchased since 1938 from Carrie Estelle Doheny and the Los Nietos Company.

LPG Committee Named

Walter S. Hallanan, chairman of the National Petroleum Council, announced appointment of the committee on Liquefied Petroleum Gas (1949-1950 committee), in response to a request by the Department of the Interior for a study on the present liquefied petroleum gas situation, including the production and transportation of liquefied petroleum gas. The committee's study will be submitted to the council with such recommendations as may be deemed appropriate. This report will supplement the one made to the council in 1948.

W. K. Warren, Warren Petroleum Corporation, Tulsa, Oklahoma, has been designated as chairman and the following as members: Fayette B. Dow, National Petroleum Association, Washington; C. F. Dowd, Tide Water Associated Oil, New York; J. W. Foley, The Texas Company, New York; J. H. Forrester, Stanolind Oil and Gas, Tulsa; B. C. Graves, Union Tank Car, Chicago, Illinois; W. E. Huston, Republic Oil Refining, Pittsburgh, Pennsylvania; Arthur C. Kreutzer, Liquefied Petroleum Gas Association, Inc., Chicago; John F. Lynch, LaGloria Corporation, Corpus Christi, Texas; Joseph Miller, Humble Oil and Refining Company, Houston; J. R. Parten, Woodley Petroleum Company, Houston; K. W. Rugh, Phillips Petroleum Company, Bartlesville, Oklahoma; A. R. Thomas, Shell Oil Company, Inc., New York; and, J. W. Vaiden, Skelly Oil Company.

Gulf Expands Public Relations

The Gulf Oil Corporation has announced the expansion of its public relations program and the appointment of three regional public relations representatives. The activities will be under the general direction of J. F. Drake, chairman of the board, and S. A. Swensrud, president. Immediately supervising the program will be W. R. Huber, who for the past three years has directed the firm's public relations efforts.

John M. Halliwell will represent the company in the Pittsburgh general office and in the Midwest area. Warren M. Drew, in New York, will direct activities in the East. Don Riddle, Houston, is assigned the Southwest.

Halliwell started with the company following his graduation from University of Pittsburgh, in 1935. Drew, an alumnus of the University of Illinois, joined Gulf shortly after his return from World War II. Riddle, a Gulf employee since 1933, came to the company with an advertising agency, public relations, and newspaper background. He is a graduate of Simmons College, Abilene, Texas.

At the Nomads luncheon, entirely social in character, held in Upper Tower room, Stevens Hotel, Chicago, November 9, during American Petroleum Institute meeting, 175 Nomads and their guests, from Dallas, Houston, Los Angeles, New York, and Tulsa chapters attended this function, presided over by R. J. Eiche, Los Angeles, chairman of the National Board of Regents. Seated at the head table, left to right, are: M. D. Gilbert, regent, Tulsa; Homer Thornhill, regent, Houston; Val

Wisconsin University Offers Adult Engineering Courses

Two institutes in engineering fields —industrial product design and tool engineering—are among the adult educational courses to be held on the University of Wisconsin campus.

The industrial product design institute, an outgrowth of increasing interest shown in the work of the industrial designer, is intended to have value for consumers, manufacturers, and industrial engineers. It will run from December 12 to 15.

Tool engineering, scheduled for December 27-30, is planned for supervisory personnel responsible for tool design work and will present latest developments and improved techniques in this field.

Retiring API Head Honored

Nearly 200 oil men paid tribute to William Rufus Boyd, Jr., at a testimonial dinner at the Stevens Hotel, November 7. It was the occasion of his retirement as president of the American Petroleum Institute. The guests were the members of the board of directors of the Institute and other close personal friends of Boyd.

W. Alton Jones, president of Cities Service Company, was chairman of the dinner committee, and L. S. Wescoat, president of Pure Oil Company, vice chairman. Jones, as master of ceremonies, presented Boyd with a silver service, a gift of the directors.

A scroll on parchment, bound in leather, was presented to Boyd, at a general session, with the signatures of 126 of the Institute's directors.

Phillips, Wasatch Merge

Final steps in the merger of Wasatch Oil Company into Phillips Petroleum Company, which is Wasatch's present parent company, have been made. This merger, which has been in process for more than two years, was completed November 1, by Phillips taking over the present assets of Wasatch.

Petroleum products will continue to be sold under both the Phillips 66 and the several Chief trade names. It is anticipated that all Wasatch installations will continue to be manned by the present personnel.

AGA Reports 13% Gas Sales Gain

Total sales of gas by utilities to ultimate customers in September were 2,428,633,000 therms, an increase of 12.7 per cent over 2,155,668,000 therms sold September, 1948, the American Gas Association reported. For the 12 months ended September 30, 1949, total sales of gas amounted to 34,481,049,000 therms, an increase of 9.7 per cent compared with 31,440,460,000 therms sold in the comparable period a year earlier. The Association's index of gas sales for September 30, 1949 was 223.7 per cent of the 1935-1939 average.

Natural gas sales in September, 1949 totaled 2,212,153,000 therms, an increase of 14.1 per cent over 1,938,878,000 therms sold in September, 1949. For 12 months ended September 30, 1949, natural gas sales were 31,026,519,000 therms, a gain of 11.7 per cent over 27,774,705,000 therms sold a year earlier. The index of natural gas sales for September 30, 1949 were 236.4 per cent of the 1935-1939 average.

Wittich, Jr., regent, New York; F. C. Ripley, Jr., regent and national secretary-treasurer, Los Angeles; R. J. Eiche; Ted Sutter, former board chairman, Los Angeles, and one of the society's founders; H. M. Cosgrove, executive secretary, Tulsa; James W. Reed, president, New York chapter.

Directors for the Nomads board were elected at a business meeting November 7 to serve for the coming year of 1950.

When the petroleum industry decides to do a job, it really does it!

On January 13, the National Petroleum Council recommended that every company in the industry support the U. S. Treasury Department in spreading the national debt through the widespread sale of Savings Bonds. On February 24, the American Petroleum Institute passed a similar resolution.

The period April 18 to May 14 was designated for the industry's special attention to organizing its Payroll Savings Drive.

Top-level oil executives responded to the call. The trade press joined in. Person to person canvasses of their employees were conducted by the individual companies throughout the country. The record to date shows how an industry's enthusiasm and cooperation can be translated into thousands of employees practicing thrift on a systematic basis through the Payroll Savings Plan for U. S. Savings Bonds.

This achievement is increasing the economic security of the nation. It is benefiting each company that promotes the Plan because, as experience in 20,000 large companies in other industries proves, participation in Payroll Savings boosts the morale and productivity of individual employees. And it will have a valuable impact on the rest of American business—as an example of what an outstanding industry can accomplish with old-fashioned intelligence, determination, and teamwork.

The Treasury Department acknowledges with appreciation the publication of this message by

THE PETROLEUM ENGINEER

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PERSONALS

▸ **A. A. O'Kelly,** associate director of the research and development department, Socony-Vacuum Oil Company, Inc., Paulsboro, New Jersey, has been elected president of the petroleum division of American Chemical Society. He takes office January 1, 1950.

▸ **L. R. Owen** will become manager of the foreign shipping department of Socony-Vacuum Oil Company, Inc., on January 1. He succeeds the late J. T. Lockwood.

H. R. Arnold, general manager of the company's Levant division, will become a member of the foreign trade committee in charge of Turkey and Greece, succeeding Owen.

▸ **James J. Delaney** has been appointed advertising manager of the Sinclair Refining Company. Delaney was formerly a vice president of Morey, Humm & Johnstone, Inc., and prior to that he was an account executive with McCann-Erickson, Inc. Delaney's 20 years of advertising and promotion experience also includes eight years as assistant advertising manager of Cities Service Company.

▸ **William G. King, Jr.,** assistant general sales manager, was elected vice president of Richfield Oil Corporation and appointed general sales manager of the Corporation, succeeding the late William T. Dinkins. King has been associated with Richfield for the past 20 years.

▸ **F. J. Toth** has been appointed superintendent of Shell Oil Company's San Joaquin division.

R. R. Robison, formerly superintendent of San Joaquin division, has been transferred to Shell's Coastal division in the same capacity.

J. R. Harman has been appointed superintendent of Shell's Coalinga district to supervise the extensive holdings of the company in that area.

▸ **R. L. Minckler,** president of General Petroleum Corporation, Los Angeles, has been re-elected for a third term as a member of the board of directors of the National Industrial Conference Board.

Founded in 1916, the conference board is an independent, non-profit, fact-finding organization, which explains and distributes facts essential in setting management, labor and governmental policies that foster industrial and economic progress.

▸ The board of directors of Los Nietos Company, a wholly-owned subsidiary of Union Oil Company, today announced the election of new officers of the company together with the new location of the company's headquarters at 617 West 7th Street, Los Angeles.

Officers of Los Nietos Company are: **Reese H. Taylor,** president; **W. L. Stewart, Jr.,** executive vice president; **A. C. Rubel,** vice president; **A. C. Stewart,** vice president; **H. W. Sanders,** vice president and treasurer; **L. A. Gibbons,** vice president and general counsel; **R. F. Niven,** secretary; **Irving Hancock,** comptroller; **W. H. Steele,** assistant comptroller; **H. A. Lapham,** assistant comptroller.

The board of directors of Los Nietos is comprised of Taylor, W. L. Stewart, Jr., Rubel, A. C. Stewart, Sanders, Gibbons, and Niven.

▸ **Joseph E. Keller,** Washington attorney, has been appointed special representative for the central committee on radio facilities, American Petroleum Institute.

The work of the central committee on radio facilities is of vital interest to the petroleum industry, as it is expanding its use of radio in production work, off-shore drilling operations, pipe line and other land transportation, aviation, maritime, and in many other operations.

The frequency coordination work and the allocation problems that will develop as the industry expands its present facilities will present added responsibilities for the committee and new opportunities for industry cooperation.

▸ **Miller W. Conn,** manager of the Perco Petroleum Company, Bartlesville, Oklahoma, has been appointed assistant manager of the chemicals-products department of the company, and will be in charge of the Perco, special products, and drilling-specialties division. Conn joined Phillips in 1936.

Dale Fischbeck succeeds Conn as Perco division manager. He is former service engineer of the division. Fischbeck has been with Phillips since 1946.

▸ **Benedict Saurino,** manager of Sun Oil Company's statistical research department, was installed as president of the Philadelphia chapter of the American Statistical Association.

J. Howard Pew

▸ **J. Howard Pew,** director and retired president of Sun Oil Company, Philadelphia, and one of the founders of the American Petroleum Institute 30 years ago, was named as the 1949 recipient of the "Gold Medal for Distinguished Achievement" awarded annually by the Institute to an outstanding American.

Pew received the Gold Medal in person at the API's 29th annual meeting in Chicago, Illinois. The formal presentation was made at a general session in the Grand Ballroom of the Stevens hotel on November 9. Pew, a graduate of Massachusetts Institute of Technology, joined Sun Oil in 1901.

▸ **Curtis H. Baylor,** former professor of medicine at the American University of Beirut, Lebanon, has been appointed assistant medical director of The Texas Company. A native of Virginia, Baylor was graduated from John Hopkins Medical School. He went to Beirut in 1938 as assistant professor of medicine at the university and was successively associate and full professor.

▸ Stanolind Oil and Gas Company has announced two changes of personnel involving men in supervisory positions in the company's North Texas-New Mexico division.

C. L. Kelley, formerly assistant field superintendent of Stanolind's Slaughter area at Brownfield, Texas, has been named field superintendent there to replace **L. L. Bechtel,** who recently retired under Stanolind's pension plan.

E. R. Wagner, who had been plant superintendent at Slaughter Gasoline plant, is being transferred to the North Cowden Gasoline plant at Odessa, Texas, as superintendent. He will head the new plant office which Stanolind has established to serve the North Cowden plant.

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▸ **M. A. Wright,** native of Blair, Oklahoma and Oklahoma A. & M. College graduate, has been named deputy coordinator of Standard Oil Company (New Jersey), effective November 1.

Wright joined The Carter Oil Company as an engineer in 1933, immediately after graduation from Oklahoma A. & M. with a civil engineering degree. He worked in the Seminole field, later was chief engineer and production manager for Carter before going to New York in January, 1946 as executive assistant in the producing coordination department of Jersey.

M. A. Wright

▸ **Joseph E. Pogue,** distinguished oil economist and head of the Chase National Bank's petroleum department, will relinquish his position as a Chase vice president at the end of the year but will retain his close affiliation with the bank in a consulting and advisory capacity on a part-time basis. He will continue to have his present office in Chase building, New York.

Pogue came to the Chase in 1936 at the invitation of Winthrop W. Aldrich, chairman, to organize a petroleum department, a new development in the field of commercial banking. The departmental staff now includes officers specializing in oil loans, as well as engineers, geologists and statisticians with long experience in the oil industry.

▸ **Leigh M. Battson,** formerly president of Los Nietos Company, has been elected to fill a vacancy on Union Oil Company's board of directors. Battson will represent the Union Oil shares acquired by the five Doheny grandchildren as a part of Union Oil Company's recent purchase of Los Nietos Company. The shares were acquired for investment purposes.

L. A. Gibbons, who has been general counsel of Union for nine years, was elected a vice president of the company and will continue his services as general counsel.

▸ **George Freyermuth,** manager of the public relations department of the Standard Oil Company (New Jersey), New York, was elected 1950 chairman of the Oil Industry Information Committee. Freyermuth will succeed **Conger Reynolds,** manager of the public relations department, Standard Oil Company (Indiana).

Three vice chairmen also were elected. They are: **Phillip Humphrey,** The Texas Company, New York; **Stanton Smith,** of Smith Oil and Refining, Rockford, and **William Gerwe,** of Socony-Vacuum Oil Company, Inc., Chicago, Illinois.

The Oil Industry Information Committee has recently expanded from 24 to 35 members.

▸ **Robert F. Hannan,** formerly executive vice president and secretary-treasurer, was elected president of California Commercial Company, a wholly-owned subsidiary of Standard Oil of California. **Warren Burns,** public relations representative, was elected a vice president. **William E. Burnett,** formerly office manager, was elected secretary-treasurer.

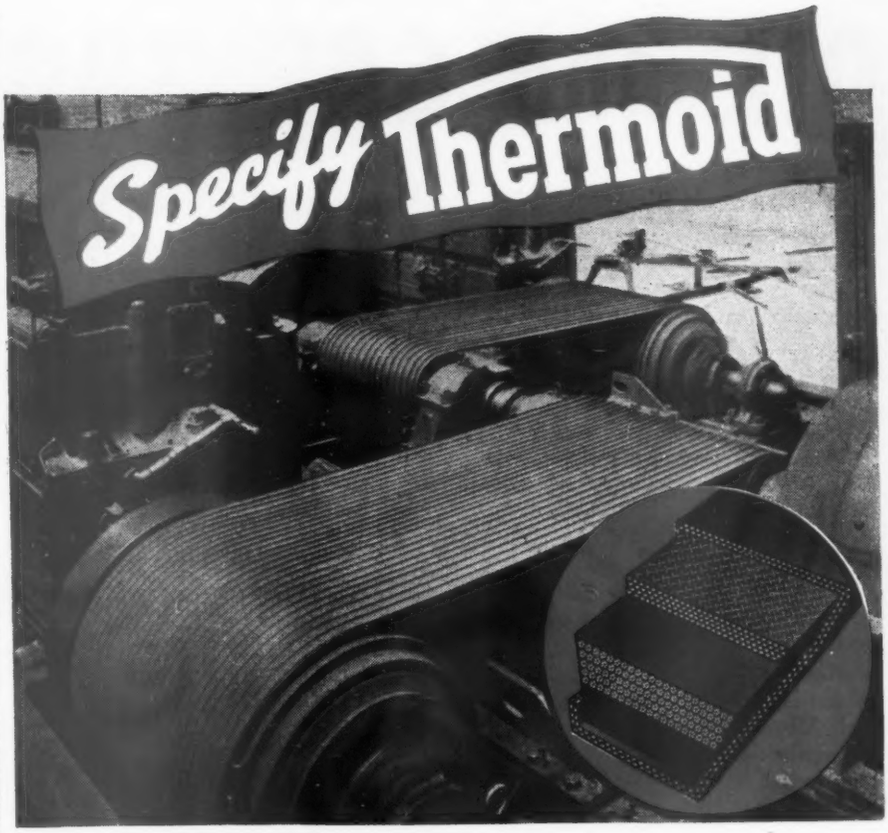
Hannan has been in the New York office of California Commercial and the parent company for 22 years. Burns worked for newspapers and oil trade publications for 15 years before joining California Commercial Company last year. Burnett joined the company in 1946.

▸ **Colie B. Whitaker,** Atlanta, Georgia, president of Whitaker Oil Company, has been made director of the Bank of Atlanta.

▸ **Howell R. Adair** has been named purchasing agent for the Southwest production division of Sun Oil Company, succeeding **Ira C. Jared** who is being relieved of his primary duties at his own request after 31 years with the company. Jared will remain with Sun to serve in an advisory capacity to the purchasing department he directed for the past quarter century.

Sun's Dallas offices are transferred from the First National Bank Building and other buildings to the new Rio Grande National Building on Field Street. Adair, former assistant to Jared, joined the purchasing department soon after he came with Sun Oil Company in 1933.

▸ **Lloyd N. Unsell,** formerly associate editor of *The Independent Monthly,* has assumed charge of the IPAA Information Service to handle press and radio relations. In this capacity, he will make all press arrangements at our various meetings, and will direct preparation of press and radio information that is sent from this office from time to time.



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OIL AND GAS TRADE NEWS

Hyatt Expands Plant

H. O. K. Meister, general manager, Hyatt bearings division, General Motors Corporation, announced that work has commenced on a 125,000 sq ft extension to its second plant in nearby Clark township.

The original New Jersey Hyatt plant in Harrison, has been producing roller bearings for automotive, agricultural, industrial, and railroad applications for over 50 years.

Filtrol Heads Meet

Operative heads of the Filtrol Corporation's international distributing organization came from their headquarters in the British Isles, Belgium, Colombia, Venezuela, Denmark, Holland, Mexico, New Zealand, and the Philippine Islands, to Los Angeles October 10.

One of the purposes of the world-wide gathering in Los Angeles was to give the foreign agents an opportunity to see at first hand Filtrol's new Vernon plant—the world's largest natural catalyst, adsorbent, and desiccant manufacturing unit.

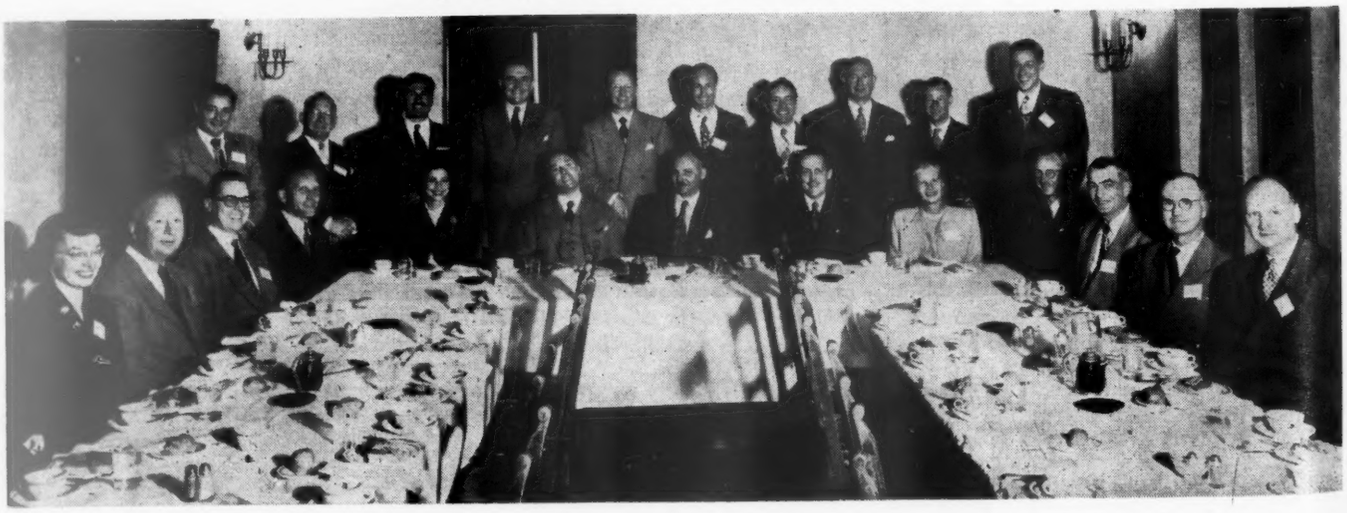
During the five-day session headed by Wright W. Gary, president, and Stanard R. Funsten, sales manager, this foreign group reviewed latest technological improvements in the oil refining industry. A special technical session was held to review latest American methods in fatty oil refining, application of desiccants (drying agents) in packaging, and the new Filtrol coated seed development.

Core Laboratories To Represent Oil Base, Inc.

Core Laboratories, Inc. of Dallas, Texas, will represent Black Magic oil base drilling fluid, White Magic oil-emulsion mud and mud conditioning products manufactured by Oil Base, Inc. All territories east of California, including Canadian oil fields, will be serviced from Core Lab's 14 offices and 8 warehouses. Fields in California, Oregon, Washington and abroad will continue to be served by Oil Base, Inc.

Thad Randolph, sales manager, Oil Base; Bill Davison, president, Core Lab, and George Miller, president, Oil Base, sign contract in joint marketing program.

Operative heads of Filtrol Corporation's international distributing organization met in Los Angeles recently. The five-day session was headed by Wright W. Gary, president, and Stanard R. Funsten, sales manager. The group reviewed latest technological improvements in the oil refining industry.



Lee J. Laird and J. M. Gilmore, partners in the new firm, Gil-Lair Products, Inc. The new company will be in Pasadena, California, and will manufacture the All-Flex ball-bearing swivel pipe coupling.

Gilmore, Laird Form Company

Recently announced is the organization of a joint venture involving J. M. Gilmore, proprietor of Standard Machine Works, Pasadena, and Lee J. Laird, former vice president and general sales manager of Chiksan Company. The new firm, Gil-Lair Products, Inc., Pasadena, California, will manufacture, under a series of exclusive patents, the All-Flex ball-bearing swivel pipe coupling, which has a wide diversity of industrial applications. The swivel coupling has a precision machined ball-bearing assembly with a unique double metal fluid-backed packing which permits low torque, streamline flow, and positive seal under high pressure or vacuum.

Gil-Lair will also manufacture flexible steel hose, mud guns, circulating heads, etc., and will engage in an expansive program of sales and engineering service to petroleum, aviation, and general industries.

GM Appoints Distributor

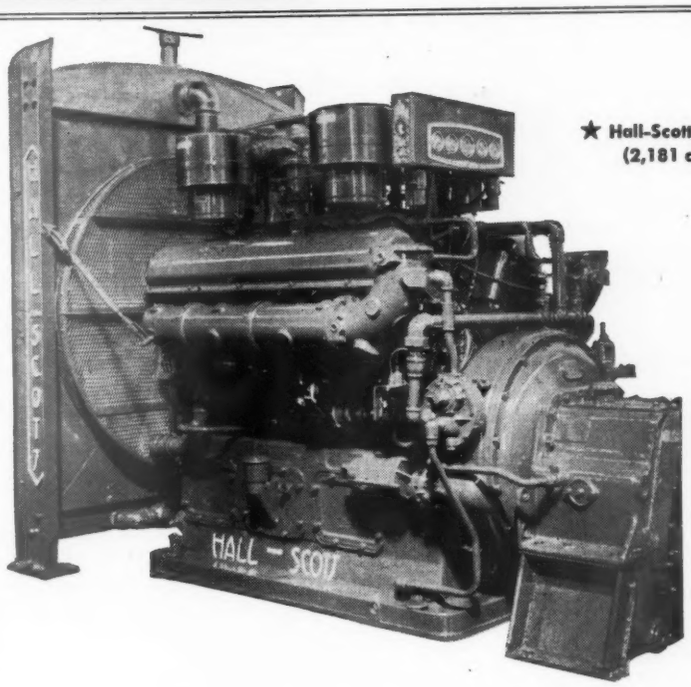
Appointment of the Colorado Builders' Supply Company of Casper, Wyoming, as distributors of General Motors Series 71 industrial and oil field diesel engines has been announced by V. C. Genn, general salesmanager of Detroit diesel engine division. The territory Colorado Builders' Supply Company will cover from Casper includes all of Wyoming except Teton. Lincoln, Uinta counties.

Colorado Builders' Supply Company is equipped to handle all GM diesel service and parts work in a well-equipped shop with experienced personnel. In addition to its present building, a warehouse 50 ft by 100 ft is now under construction.

Web Wilson to Have New Headquarters

The board of directors of Web Wilson Oil Tools, Inc. has announced that, as a result of a meeting of the directors, they have decided to expedite the plans for the construction of their new office buildings that will be located at 14905 South San Pedro Street, Los Angeles, California.

Construction of the new offices will begin before the end of this year, and completion is expected sometime early in 1950. An announcement of the grand opening of the new Web Wilson Oil Tools, Inc. offices will be made at a near date.



★ Hall-Scott V-12 Engine (2,181 cu. in. displ.)

HALL-SCOTT POWER saves money!

The Hall-Scott V-12 is a versatile performer . . . for powering draw works, drilling rigs, pumps, generators, other industrial equipment.

This engine saves you money because of (1) exceptional power-to-weight ratio, (2) unit construction, which provides for quicker servicing with minimum downtime, (3) compact design, which means greater mobility, lower transportation costs.

Like the *Series 400* Hall-Scott Engine, the V-12 is adaptable to gasoline, butane, or natural gas operation. Full details on request.

HALL-SCOTT
MOTOR DIVISION
ACF-BRILL MOTORS COMPANY

Factory and Main Office: Berkeley 2, California
Philadelphia Branch: 62nd St. & Woodland Ave.

HALL POWER BY SCOTT

Branches: Boston • New York • Chicago • Dallas • Los Angeles • Spokane • Berkeley

Announces 3 New Offices

J. F. Ray, vice president in charge of sales, General Controls, Glendale, California, manufacturers of a complete line of automatic, pressure, temperature, level and flow controls, announced the opening of new factory branch office facilities in Minneapolis, Minnesota, Buffalo, New York, and Baltimore, Maryland. This, says Ray, is in line with the established company policy to continue expansion of its sales and service facilities.

Roller Joins Republic

John S. Roller has joined Republic Supply Company as general manager of sales. Roller formerly was assistant sales manager of the Birmingham district for Republic Steel Corporation. Don L. Collins, formerly executive vice president and general manager of sales will continue his duties as executive vice president for Republic Supply Company, which has its headquarters in Houston, Texas.

Dallas Engineer Dies

Charles L. Henry, Dallas, Texas, died of a heart attack October 1, in Texarkana, where he was an engineer for the U. S. Government Arsenal. Henry was a graduate of the University of Pittsburgh. Before he went to work for the government he had been with Lee C. Moore, and Comany, Inc., oilfield equipment, where he was chief engineer at the time of his resignation.

Boyles Galvanizing Plant Open

The newly organized Boyles Galvanizing Company, Tulsa, Oklahoma, is now in operation. The plant will employ 50 workers to handle galvanizing jobs for concerns in the Mid-Continent states and some as far away as Pittsburgh and West Virginia. The most complete equipment available is being installed, including a galvanizing kettle more than 30 ft in length with a zinc capacity of 100 tons.

A four-year-old building recently purchased from the National Tank Company will house the processing activities. A Sand Springs railroad spur enters the seven acre property at either end, facilitating the arrival and shipment of steel.

Jones' Develop Sucker-rods For Pumping Deep Wells

Thousands of feet of Jones' "Slim-Joint" 7/8-in. sucker rods are being used successfully by producers in pumping some of their deeper wells that had been equipped with 2-in. tubing. Developed for this specific purpose by The S. M. Jones Company, "Slim-Joint" rods can be run and fished in the 2-in. tubing.

New officers of the Petroleum Electric Power Association are: L. V. Dugas, Gulf States Utilities, president; R. E. Patrick, Kansas Gas and Electric, vice president; T. E. Graham, Oklahoma Gas and Electric, secretary-treasurer.

Dugas Heads Electric Assn

The Petroleum Electric Power Association held its 21st annual meeting November 17-18, in Beaumont, Texas, at which time the following officers were elected: President, L. V. Dugas, of the Gulf States Utilities Company, Beaumont; vice president, R. E. Patrick, of the Kansas Gas and Electric Company, Wichita, and secretary-treasurer, T. E. Graham, Oklahoma Gas and Electric Company, Oklahoma City, Oklahoma.

Elected to the board of directors for the years 1950 and 1951 are John T. Meek, Arkansas Power and Light Company, Eldorado; Sam D. Salt, Texas Electric Service Company, Midland; R. E. Patrick, Kansas Gas and Electric Company, who is also vice president; L. W. Pearson, Southwestern Public Service Company, Amarillo, and Tom Mason, of the New Mexico Electric Service Corporation, Hobbs, New Mexico.

Marshall Heads Service

Arthur S. Marshall was appointed general service manager effective November 1, of the H. C. Smith Oil Tool Company. Marshall joined the company in 1936 and the following year was appointed foreman of the heat treating plant. He attended school at the Los Angeles City College in 1937 and at California Institute of Technology in 1938, studying special metallurgical courses.

Arthur S. Marshall receives congratulations from H. C. Smith on his recent appointment to general service manager of the H. C. Smith Oil Tool Company.

Greene Organization Expands

Gordon Z. Greene, long time West Coast oil and gas specialist, has announced the expansion of his organ-

Gordon Z. Greene

ization and interests. The firm, Gordon Z. Greene Company, is now exclusive distributor in California for Commercial Iron Works of Los Angeles, manufacturer of leveling saddles, and orifice fittings, including orifice flanges and meter plates. It is also exclusive agent on the Pacific Coast for the Vulcan Proofing Company of Brooklyn, New York; California agent for the Chaplin-Fulton Manufacturing Company of Pittsburgh, Pennsylvania; and represents Research Control Instrument Company of Tulsa, Oklahoma.

The Greene Company also has made to its own specifications in various Los Angeles machine shops such items as meter houses, thermometer wells, pressure gauges, drip pots, large capacity gas filters, calibrated and bored meter runs, and other items pertinent to the natural gas processing and refining industries.

Bethlehem Gets New Offices

Bethlehem Supply Company has announced the establishment of its new Fort Worth headquarters in Rooms 724 and 725, Fair Building. J. C. Knoll and C. E. Medley will make their headquarters at the new address.

Koppers Plan to Build Pipe Line Coatings Plant

Plans for construction and operation of an industrial protective coatings plant of 25,000-ton annual capacity at Port Arthur, Ontario, by the By-Product Coke Company of Canada, Limited, a wholly-owned subsidiary of Koppers Company, Inc.

Coal tar base coating produced at the plant will be applied to pipe lines transporting oil and natural gas from the rich Alberta oil fields, General Somervell said. Initial contracts call for the delivery of 15,000 tons of enamel coatings for application on the Edmonton, Alberta, to Duluth, Minnesota, pipe line of Imperial Oil, Ltd., and an associated company.

How Fast and Easy You Can String a WECO Snatch Block

When you're working with a WECO Block, you string or unstring it easily and quickly at any time, whether or not there's weight on the line. There's no trick manipulation, no "wrestling" to release or secure the side . . . you simply unscrew a nut, lift the side, insert or remove the line, drop the plate and replace the nut. After placing the line in the sheave, it is not necessary to lift either the weight of the line or the block to secure the side. There's never any need, of course, to reeve the block with the end of the line.

Other WECO features . . . full swiveling forged steel hook, heavy shell plates, forged sheave with accurately gaged, rope-saving groove, heavy hardened and ground sheave pin, "Super Oilite" bearing . . . combine with the time-saving "Drop Side"* to make WECO Snatch Blocks the finest available. Specify them for the ultimate in speed, safety and service. Available with full swiveling hook or clevis in 6", 8" and 10" sizes for wire or manila rope.

*** Patent Nos. 2,235,302 & 2,288,116**

SOLD THROUGH SUPPLY STORES EVERYWHERE

YOUR WECO REPRESENTATIVE can furnish you with helpful information on the use and care of snatch blocks and wire lines. Applied in your operations, this information will effect great savings in time and materials.

WELL EQUIPMENT MFG. CORP.

Subsidiary of Chiksan Company
HOUSTON 1, TEXAS
Exclusive Sales Representative Outside Mid-Continent Area
CHIKSAN COMPANY
Brea Calif. New York 7
Export Sales: CHIKSAN EXPORT COMPANY, Brea Calif. New York 7

WECO

Manufacturers and Distributors of Oilfield, Refining, Marine and Industrial Equipment

Sikes Joins H. & P., Inc.

Helmerich & Payne, Inc., Tulsa, Oklahoma, has announced the association with that company of Dee A. Sikes. Sikes, widely known in production and drilling circles throughout Mid-Continent, Gulf Coast, and Rocky Mountain areas, will assume responsibilities in connection with the management of the company and will make his headquarters at Tulsa.

Helmerich & Payne, Inc. are actively engaged in drilling operations in the states of Oklahoma, Texas, New Mexico, Louisiana, and Mississippi, with three district offices.

Opens Elk City Store

Bethlehem Supply Company has announced the opening of a new oil field supply store at Elk City, Oklahoma.

The Elk City store will carry a complete stock of oil field drilling and production equipment required to meet the needs of the oil industry in this vicinity. J. W. Strickland, the Bethlehem field representative who has been in the Elk City area for the past six months, has been chosen as store manager and field representative for the new store. The assistant store manager will be P. W. O'Brien, who was transferred from Wewoka, Oklahoma.

Exhibit Chemical Equipment

%Proportioneers, Inc.%, Provi dence, Rhode Island, manufacturers of chemical proportioning equipment, held an exhibit at the 22nd Exposition of Chemical Industries at Grand Central Palace, New York, November 28 to December 3, 1949.

The largest unit on display was a %Proportioneers% continuous volumetric blender for lubricating oils and other synthetic process applications. The unit was in operation and demonstrated the blender's automatic features and high accuracy on repeat batch performance. The blender was full size and of the type used by major petroleum companies.

Murray Gets New Testing Laboratory

The Murray Rubber Company of Houston, Texas, has announced the completion of a modern testing labo

H. S. Brenner

ratory for the development and control of natural and synthetic rubber compounds. The new laboratory is equipped and staffed to provide laboratory tested rubber compounding and molding, and to assure close laboratory control of all mechanical rubber goods produced in the plant. according to Lynne Murray, general manager.

H. S. Brenner will direct operations of the new Murray laboratory. He is a well known rubber chemist with many years of experience in some of the nations largest mechanical rubber goods and rubber tire plants.

To Handle Kerotest Products

Kerotest Manufacturing Company of Pittsburgh, Pennsylvania, has announced that Kerotest cast steel products will be manufactured and distributed in the Dominion of Canada by Guelph Engineering Company, Ltd., Guelph, Ontario, Canada.

This line of products includes flow line valves, drilling valves, pipe line valves, tank valves, refinery and industrial valves, cast and forged steel fittings, control chokes, tubing heads, casing heads and other oil field specialties. These products will be known and marketed as Acme-Kerotest.

TRADE PERSONALS

▸ **Robert E. Clark, Jr.** has been named general sales manager for the Eastman Oil Well Survey Company, with headquarters in the general office at Denver, Colorado. **Robert C. Hill** has been appointed Rocky Mountain-Mid-Continent division sales manager at Denver.

A graduate of the University of California, where he majored in geology, Clark started his oil career in the drilling department of the Shell Oil Company of California at Ventura.

Hill, who joined the Eastman Company in 1946, has been in charge of electronic sales and service at the Long Beach, California, office. He is a graduate of the University of Colorado, with a BA degree in petroleum engineering and oil geology.

▸ **William C. Bruton** has been named district sales manager for American Manganese steel division of American Brake Shoe Company, and **Robert H. Elem** has been appointed Pacific Coast manager of the welding products department.

Bruton, formerly sales engineer, joined Brake Shoe in 1916. His territory covers the Pacific Northwest.

Elem, formerly welding engineer, is a graduate of the University of Southern California. During World War II he served with the Army Signal Corps in the Pacific area.

▸ **Fred Thilenius** has been named manager for the newly created Mid-Continent district of the France Packing Company of Philadelphia, Pennsylvania. Offices will remain at 303 East Fourth Street, Tulsa, Oklahoma. The new district office will serve as sales headquarters for a much larger area, which includes the states of Kansas and Oklahoma, North and West Texas, including the Panhandle, and Southeast New Mexico. Thilenius has served the France Packing Company as sales representative for some time and is known to many in the territory.

▸ Wilson Manufacturing Company of Wichita, Falls, Texas, announces the appointment of **W. C. Langley,** Barranquillo, Colombia, South America, as manufacturer's agent for Venezuela, Colombia, Peru, and Trinidad. Langley has been a manufacturer's representative in South America for about 10 years with headquarters in Barranquillo. He plans to offer a complete parts and service department for Wilson there.

▸ The retirement on December 31, 1949, of **C. E. Whitney,** vice president and assistant general manager of Baker Oil Tools, Inc., will mark the finish of a long and successful association with Baker.

Following the San Francisco earth-

C. E. Whitney

quake and fire in 1906, "Whit" as he is known to a host of friends throughout the oil country, learned of an oil boom at Coalinga, California, and recognized this as an opportunity to open a retail store that developed into a sizeable department store. It was inevitable that he would become interested in the oil business at Coalinga, and acquainted with R. C. Baker, Sr., later to become a prominent and colorful figure in the industry.

In 1912, Whitney became associ-

R. W. Henderson R. L. Turner

ated with P. M. Pike of the Federal Drilling Company, in California; and in 1916 the Patterson-Whitney Drilling Company was organized for the operation of both cable and rotary tools in Oklahoma and North Texas.

Whitney became connected with Baker Oil Tools, Inc. in 1927 as a sales engineer, and served successively as purchasing agent, secretary-treasurer, and vice president-general sales manager. In 1936 the company established a manufacturing plant, warehouse, and sales office in Houston, and he was placed in charge as vice president and assistant gneral manager.

Following his retirement at end of year, Whitney will continue his residence in the vicinity of Houston, with time to visit with his many friends in the oil country.

Effective January 1, 1950, **Roy W. Henderson** will assume the duties of assistant general manager in charge of the central division of Baker Oil Tools, Inc., succeeding C. E. Whitney who is retiring.

Henderson, who is still on "the sunny side" of forty, is a splendid example of progress without missing a rung on the ladder. Starting with Baker in 1935 as a shop helper sweeping chips and moving material, he moved upward through various shop operations, serving as stock clerk and order clerk, and became purchasing agent and manager of materials control in 1943.

For the past seven years Henderson has been active in the Los Angeles Purchasing Agents Association, and is now serving as chairman of the membership committee. Leisure time activities include fishing, hunting, golf and tennis, to which he devotes the same enthusiasm as to business.

Succeeding Henderson as purchasing agent at Los Angeles will be **R. L. (Dick) Turner,** who has been connected with Baker since 1934, with time out for three and one-half years service with the United States Marine Corps. Turner started his association with Baker Oil Tools, Inc. in their Houston warehouse, and since the war has been in the Los Angeles office serving as staff assistant on special administrative assignments.

▸ **Milford R. Waddell,** vice president and director of the National Industrial Advertising Association spoke at a recent meeting of the Dallas Chapter of NIAA. The subject of his address was "Some New Concepts of Industrial Advertising."

Waddell is director of the industrial and public relations division of Black, Sivalls, and Bryson. His company has been serving the oil industry for the past 57 years.

▸ **J. B. O'Connor,** vice president of Dresser Industries, Inc., is at present in Europe on a business trip. He is visiting London and Paris and may also make a stop in Switzerland.

Fred Denig, vice president, has been made manager of Koppers Company, Inc., production department, and **G. Frank D'Alelio** has been named vice president and manager of the research department, the position formerly held by Denig.

The changes were made necessary by the resignation, because of ill health, of **Hugh C. Minton,** vice president who has headed the production department.

A. R. Powell, who has been assistant manager of the research department, has been made associate manager of that department.

Denig, who joined Koppers in 1921, has been a vice president and manager of its research department since 1934. D'Alelio joined Koppers in 1947, as an assistant manager of the research department. Powell joined Koppers in 1923 after four years research on coal, gas, and other fuels for the U. S. Bureau of Mines.

Kenneth A. Field was appointed service manager of the Wellsville (New York) works, by Worthington Pump and Machinery Corporation. Field holds a BS degree in mechanical engineering from the University of Maine, and has done graduate work at the Illinois Institute of Technology.

R. D. Waterman was appointed executive vice president of E. B. Badger and Sons Company, process engineering and construction concern of Boston, Massachusetts. Announcement is also made of the election of three vice presidents of the company, a subsidiary of Stone and Webster, Inc.: **A. J. Broggini,** vice president and sales manager, in charge of foreign and domestic sales; **A. J. Connell,** vice president and engineering manager, in charge of all engineering, drafting, estimating and procurement, and **A. J. Good,** vice president in charge of office management, contracts, and engineering and construction cost analysis.

V. J. (Mike) Mercier has been named sales manager for the Mountain Iron and Supply Company of Wichita, Kansas.

Mercier, formerly with Lane-Wells Company, is widely known throughout the Mid-Continent for his many papers on well logging and geophysics. He is presently chairman of the Kansas section of the American Institute of Mining and Metalurgical Engineers, an active member in the American Association of Petroleum Geologists, the Society of Exploration Geophysicists, the American Petroleum Institute, Kansas Geological Society, the Kansas Independent Oil and Gas Association, and is also secretary and director in the Petroleum Club of Wichita.

F. L. McClellan was appointed assistant manager and superintendent of stores for Mountain Iron.

Orlan Webb, export service engineer for Baker Oil Tools, Inc., together with Mrs. Webb, has spent his home leave fishing along the Texas Gulf, and visiting friends in the oil business in Southern California.

Prior to his work with Baker, Webb filled a foreign assignment with Aranca in Saudi Arabia. The Webbs returned to their headquarters at Santa Barbara in Eastern Venezuela late in October.

Sam G. Gary is the new manager of Core Laboratories' Canadian operations.

Stephen C. May has been named vice president and general sales manager of Blackmer Pump Company, Grand Rapids, Michigan. May has had extensive contact with petroleum producing and marketing, chemical processing, general industrial and jobbing applications of hydraulic equipment. He was formerly consulting sales counselor with Auto-Soler Company.

Appointment of **Anthony H. Lamb** as vice president of the Weston Electrical Instrument Corporation, Newark, New Jersey, has been announced by Earl R. Mellen, president. Lamb, employed by the Weston corporation since 1924, will assume responsibility for the operation of the Tagliabue Division of the company, reporting directly to the president.

William J. McQuillan has been promoted to the position of branch manager, Pittsburgh office, Morse Chain Company, division of Borg-Warner Corp. Prior to joining the sales staff of Morse Chain, in 1948, McQuillan was associated with the sales department of H. H. Robertson Company, of Pittsburgh, Pennsylvania, after several years in the engineering department of Blaw-Knox.

David H. Conklin, West Coast district manager for Du Pont's petroleum chemicals division, has been promoted to assistant sales manager with headquarters in Wilmington, Delaware. Conklin will fill one of two assistant sales managerships in the division, reporting to Emory M. Fanning, sales manager.

George L. Tyler, West Coast sales representative, will succeed Conklin as manager of the district office in Los Angeles.

B. B. Smith has been named vice president in charge of operations, and **T. W. Wheeler** as vice president in charge of contracting for Loffland Brothers Company.

Smith is widely known in the oil and gas industry, having been actively engaged in the operation of drilling equipment for more than 30 years. He has been associated with Loffland Brothers Company for the past 15 years and until his being placed in charge of operations, has been vice president in charge of the Houston Division. Prior to coming to Loffland he had spent 15 years with Meade Brothers, Inc.

Wheeler recently joined Loffland Brothers organization where he has devoted most of his time to the securing of drilling contracts. He spent 11 years with Phillips Petroleum Company, and resigned his position as general superintendent of the core drill division in 1939 to become a partner and later sole owner of a drilling company.

George Mallory, who is now superintendent at New Iberia, Louisiana, and who has served in various supervisory capacities with Loffland Brothers Company for over 20 years, will become general superintendent in charge of the Houston division with headquarters at Houston, Texas.

J. E. Cockburn will succeed Mallory as superintendent at New Iberia. He has been associated with Loffland Brothers Company for over 22 years, the majority of which have been spent in the Houston division.

C. V. Hush, Bethlehem Supply Company, former clerk in the tubular sales department, Tulsa office, has been transferred to the Dallas sales office and promoted to the position of chief clerk.

H. C. Hoggard has recently been employed as field representative at Borger, Texas, to give additional sales coverage in that area.

B. M. Quigley, employed as field representative at the Odessa, Texas, store, has been transferred to the Sundown, Texas, store in same capacity.

▸ **Ernie Adams,** Rockwell Manufacturing Company, died October 30. He was assistant district manager of the Los Angeles office for Rockwell, having been associated with the concern for 13 years. He was a graduate of California in mechanical engineering and was well known in oil circles.

▸ **John S. Carlson,** general counsel and a director of Seismograph Services Corporation, was made general counsel for Welex Jet Services, Inc., Fort Worth, Texas. He has resigned as a director of Seismograph Service Corporation, but will continue his connection with that firm in an advisory legal capacity.

Carlson had been general counsel of Seismograph for seven and one-half years and up until May 2 of this year, had been secretary of the company, in addition to being general counsel and a director.

▸ **William Knust,** advertising manager of National Lead Company, was honored by the directors of the company at a luncheon recently in observance of his 40th anniversary of company service.

First employed by National Lead as a stenographer and bookkeeper in 1909, Knust worked his way through every division of the advertising department. He was appointed advertising manager of National Lead, 1927.

▸ **H. C. (Pee Wee) Thornton** is appointed manager of the new United Supply and Manufacturing Company store at Elk City, Oklahoma. He has been a field salesman with United at Pauls Valley, Oklahoma, and during the war was a captain in the army.

▸ **Thomas F. Fitzgerald** has been named engineering sales representative in the Boston, Massachusetts area for Hammond Iron Works of Warren, Pennsylvania. Fitzgerald is thoroughly acquainted with the requirements of the petro-chemical industries in relation to Hammond products.

▸ **Henry T. Sulcer** has been appointed general manager of Graver Water Conditioning Company, New York City. The Water Conditioning Company was recently formed to extend the water treatment and liquid conditioning facilities of the company. Sulcer had been general auditor of the parent company, which he joined in 1948 after a wide legal, industrial manufacturing, and administrative experience.

Aiding Sulcer as assistant general manager is **Edward w. Welp,** formerly sales manager of the Graver water treating division, who will make his headquarters in the Chicago office.

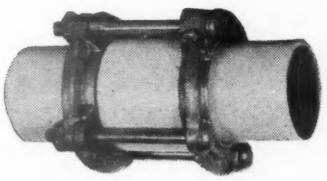
S. D. Barr, who was previously in charge of Eastern district sales, has been advanced to the position of general sales manager with offices at New York. The technical division of the company is now headed by **Vincent J. Calise.**

▸ **J. Y. Sammons** has been recently added to the industrial chemical sales staff of Spencer Chemical Company. He will be in the New York office.

Sammons, a graduate of the University of Tennessee, was associated formerly with the Barrett division of Allied Chemical & Dye Corporation.

▸ **James Herrick,** vice president of the Cardwell Manufacturing Company, and Mrs. Herrick left New York the first of November for an extended business trip through Europe, the Middle East, and Far East. Herrick will call on oil companies in all of the active fields and will be gone from the United States approximately four months.

The trip from New York to the Far East will be made in an airplane being flown out there by Herrick and a crew of Standard-Vacuum pilots for delivery to Palembang, Sumatra. Cardwell Manufacturing Company is situated in Wichita, Kansas.



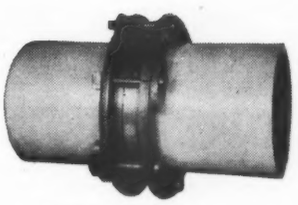
COLLAR CLAMP
Styles 4 and 41, for repairing and preventing leaks through threads of screw collars.

BAND CLAMP
Style 77B, for repairing small leaks and holes in the run of pipe.

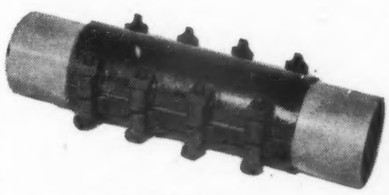
FIX LEAKS-without shutting down

Keep line contents moving while you stop leaks. Just put a Dresser Repair Clamp around the leaking pipe and tighten the bolts. Dresser Grade 29 Gaskets offer you special advantages for a permanent leak-proof seal.

Be ready for fast repairs by keeping Dressers in stock. The four styles shown here are just part of Dresser's complete line of repair products, available at your nearest oilfield supply store—or direct from our Houston warehouse. Overnight delivery throughout the southwest. For further details, write for our Oilfield Catalog.



POROUS-WELD CLAMP
Style 55, for repairing circumferential weld leaks.



SPLIT REPAIR CLAMP
Style 79B, for repairing pitholes and longitudinal splits in pipe.

DRESSER REPAIR CLAMPS

ONE OF THE DRESSER INDUSTRIES

Dresser Manufacturing Division, Bradford, Pa.—Houston Warehouse, 1121 Rothwell Street, Houston, Texas.

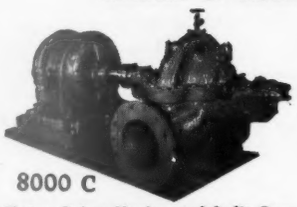
DEAN BROTHERS PUMPS INC.
INDEANAPOLIS, INDEANA.
PUMPING MACHINERY

CENTRIFUGAL PUMPS

RECIPROCATING PUMPS

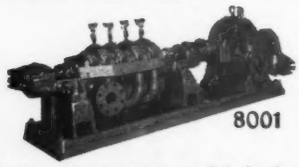
PUMPS

BUILDERS OF OUTSTANDING PUMPS SINCE 1869



8000 C

Motor Drive Horizontal Split Case Double Suction Centrifugal Pump

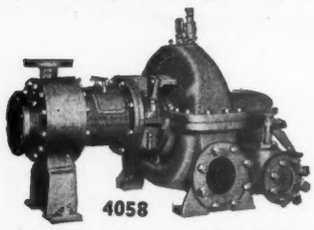


8001

Turbine Drive Horizontal Split Case Multi Stage Centrifugal Pump

4049 A

Two Stage Close Coupled Centrifugal Pump



4058

Turbine Drive Close Coupled Centrifugal Pump

942

Single Style, Packed Piston Pattern Steam Pump

2352 B

Durable Duplex, Outside End Packed, Plunger Pattern Steam Pump

3918

Durable Duplex, Packed Piston Pattern Steam Pump

3833

Horizontal Duplex, Double Acting, Side Pot, Piston Type, Oil Bath Power Pump

ESTABLISHED 1869

DEAN BROTHERS PUMPS INC.

INDIANAPOLIS IND.

323 W. TENTH ST.

▸ The election of **Mark Gardner** as president of International Derrick and Equipment Company, Cleveland, Ohio, was announced. He will make his headquarters in Dallas, Texas, where the company's headquarters are being moved. Gardner, who was also elected a director of Ideco, succeeds Oscar M. Havekotte, who served as president from 1940 until his resignation recently.

▸ **A. L. Sobey** has been appointed Chicago, Illinois, area sales representative for Smithway computing pumps, according to announcement of Harry G. Smith, manager meter division of A. O. Smith Corporation.

Operating as A. L. Sobey Equipment Company, he is establishing offices at 624 South Michigan Avenue, Chicago 5, Illinois.

▸ **Ben E. Mater,** export service engineer for Baker Oil Tools, Inc., left New York in late October on the first

Ben E. Mater

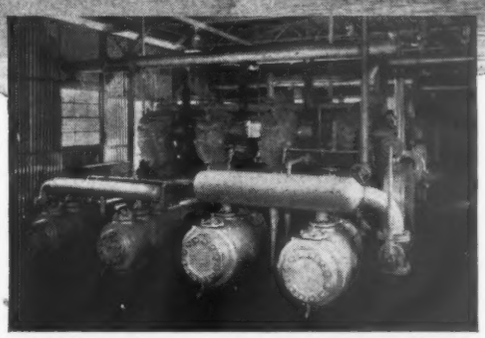
leg of a trip that will involve a total of approximately 40,000 miles of air travel. His itinerary will include the Netherlands, France, and other oil areas in Europe, as well as most of the major fields in the Near, Middle, and Far East. His purpose is to consult with and assist oil operators throughout these areas.

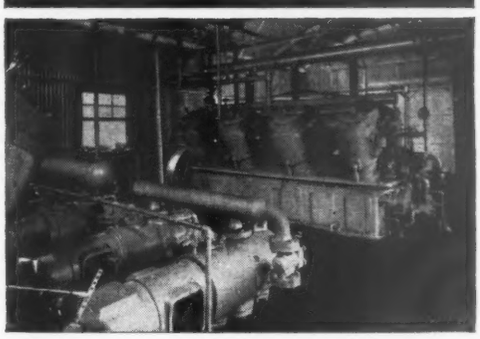
▸ Having completed a two-week training course at the Los Angeles factory, **M. Harold Dean** returns to Southern Louisiana where he will represent the Red Devil line of oil field equipment, manufactured by Oil Well Manufacturing Corporation. He will make his headquarters at Houma, Louisiana.

▸ **Max L. Murdock,** acting manager of the centrifugal pump department at Allis-Chalmers Norwood (Ohio) works, has been promoted to manager of the department succeeding **H. C. Gaton,** retired.

Woodrow Brixius, formerly application engineer in the company's West Allis works centrifugal pump department, has been named assistant to Murdock, and **Paul B. Hugenberg** has been appointed application engineer in charge of sales and orders.

"FLOATING COMPRESSORS"
for
SHELL OIL'S GAS-LIFT
IN LOUISIANA BAYOU SWAMPLAND





These two XVG gas-powered compressors, operating aboard Shell Oil Company's barge, provide something new in availability, flexibility, and operating efficiency.

Excellent running balance makes Ingersoll-Rand's XVG, and smaller JVG compressors, ideal for service on barges.

This floating compressor plant is used by the Shell Oil Company for gas-lift and sale-gas service in Louisiana bayou swampland where it is almost impossible to get sound footing for a conventional foundation. Because it is completely self-contained, the plant is easily moved from one location to another. The compressor equipment consists of two Ingersoll-Rand 300-hp Type XVG gas-engine-driven compressors, known for their excellent running balance. An I-R Type 30 air-cooled compressor furnishes starting air for the engines.

This is the second compressor barge built for Shell by the Levingston Shipbuilding Co., Orange, Texas. The first, with a single 225-hp Type XVG compressor, has been on gas-lift service at Black Bayou, La., for some time.

These compact, 4-cycle V-angle compressors, designed primarily for oil-field and refinery service, are in use all over the world on all types of jobs . . . with outstanding records of efficiency, dependability, and low up-keep costs. For complete information get in touch with your nearest I-R engineer. He will be glad to explain the advantages of Ingersoll-Rand 4-cycle Vee compressors and gas engines.

- **DEPENDABILITY**
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- **BALANCE**

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▸ **Amos W. Oakleaf** was named as Phillips Chemical Company's sales manager in charge of foreign and domestic sales of furance blacks, Philblack A and Philblack O. Oakleaf, a graduate of the University of Kansas, joined Phillips in 1944. He will make his headquarters in the Phillips Chemical Company sales office at Akron, Ohio.

Raymond J. Hull has been appointed manager of Philblack export sales, with offices in New York. **George E. Popp** has been named manager of domestic and Canadian sales of Philblack. Hull graduated from Purdue University in 1927 with a degree in chemical engineering. Popp has held important positions in the tire industry before his association with Phillips in 1945.

▸ **Frank B. Powers,** formerly assistant vice president of producton for the American Car and Foundry Company and an executive with more than 20 years of outstanding service in the engineering and manufacturing field, has been appointed director of manufacturing operations of Federal Telephone and Radio Corporation. Powers will be responsible for telephone, radio, selenium rectifier, intelin cable and vacuum tube operations of the company.

▸ **T. B. (Tom) Leech** was named sales manager for Petro-Chem Development Company, designers and fabri-

T. B. Leach

cators of furnaces, superheaters, and steam generators. Leech has been associated with the oil industry since he went to work for the Texas Company in 1916. For many years he has been with engineering or engineering sales organizations handling refinery equipment. Since 1941, he has been manager of refinery sales for Bethlehem Supply Company, resigning from that position to go with Petro-Chem.

▸ **Harold D. Gobble,** formerly manager of the oil field division of Fairbanks, Morse and Company, has been appointed manager of the Dallas, Texas, branch house. He succeeds **Harry J. Renken** who has been transferred to the company's headquarters in Chicago to become oil field division manager. Gobble joined the company in 1927.

▸ Seismograph Service Corporation of Delaware has announced the following appointments in Seiswell, well servicing division: **Hamilton M. Johnson,** division manager with headquarters in Caracas; **Jay G. Beaver,** district manager of the El Tigre area; **William H. Plowman,** sales and service engineer for eastern Venezuela, and **M. L. Richmond,** senior shooter, in charge of the Jusepin area.

Johnson graduated from the Louisiana State University in 1936 with a BS degree in physics and chemistry and an MS degree in electrical engineering. He joined SSCD in 1947. Beaver was graduated from the University of New Mexico with a BS degree in electrical engineering. He was employed by SSC in 1947.

Plowman received a degree in radio engineering at the Spartan School of Aeronautics. Upon completion of his schooling he accepted employment with SSC and in 1948 was transferred to Seiswell in Venezuela. Richmond has had many years of experience in the jet perforating field as an employee of both the McCullough Tool Company and Welex Jet Services, Inc. He joined SSCD in 1949.

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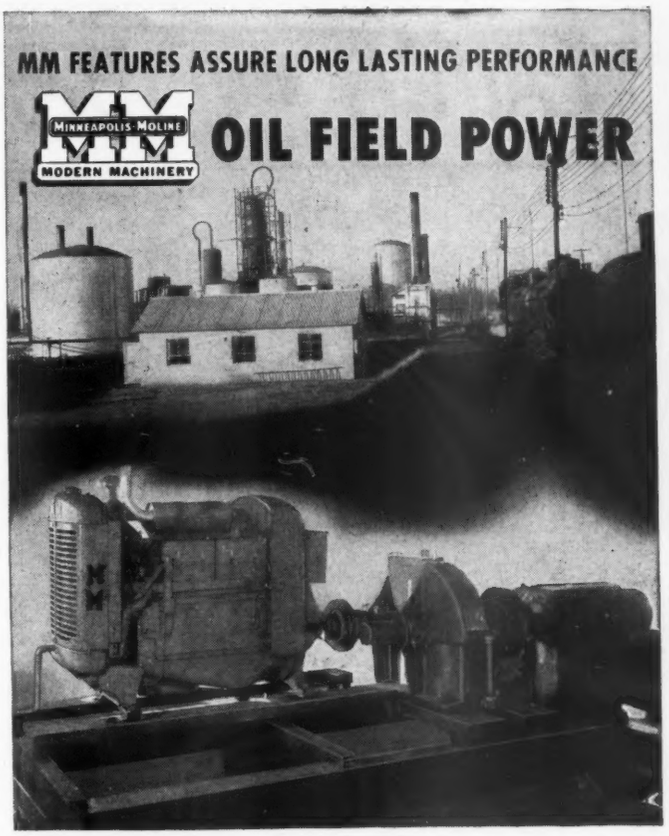

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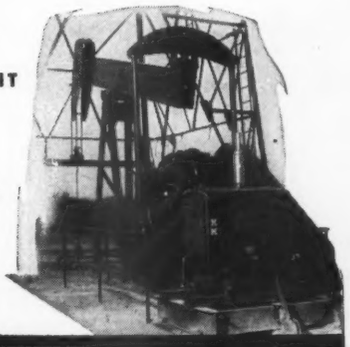

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LAUGH WITH BARNEY

Mother: Well, Sally, what did you learn at Sunday School today?

Sally: Oh, about a cross-eyed bear named Gladly.

Mother: Why, Sally, are you sure that was what the lesson was about?

Sally: Yes, Mommy. We even learned a song, "Gladly the Cross I'd Bear."

* * *

He: Please?

She: No.

He: Just this once?

She: No, I said.

He: Aw, shucks, Ma, all the rest of the kids are going bare-foot.

* * *

He: I come to bring warmth and light into the bleakness of your home.

Romantic Spinster: Oh, you dear—

He: Nix on the love stuff, old lady. I'm the installation man for the gas company.

* * *

A beautiful brunette opened the door in response to a salesman's knock. "Ah, good morning," he beamed. "May I speak to your husband for a moment?"

"I'm sorry. He's away on business, and won't be back for three weeks."

The salesman took another look at the stunning creature. "That'll be all right," he murmured. "I'll wait."

Snobbish Mother (visiting dormitory) : Do you know my son, the Right Honorable Cedric Winston Fitzclarence de Haven von Rennsalear?

Student: Oh, sure, I'll tell Stinky you're here.

* * *

"What are you crying about, my little man?" asked the aged stranger of the little boy.

"I can't do anything," sobbed the little fellow.

So . . . the old man sat down beside him and cried, too.

* * *

"Hey, Pop, the old goat just ate my rabbit!"

"Gad! Another hare in the butter."

* * *

"How do you like your new boss, Helen?"

"Oh, he ain't so bad, Marge, only he's kinda bigoted."

"Whadda y' mean, bigoted?"

"Well, he thinks words can only be spelled one way."

* * *

Waiter: Mr. Brown left his umbrella again. I believe he'd leave his head if it were loose.

Manager: Yes, guess you're right. I heard him say yesterday, he was going to Arizona for his lungs.

* LANE-WELLS SHAPED-CHARGE PERFORATING-THAT IS!

Suzie: Well, I finally got a raise in salary!

New Stenog: Honestly?

Suzie: Oh, don't be so inquisitive.

* * *

Once upon a time a man got up early on Sunday morning to let the iceman in, and being unable to find his bathrobe, he slipped on his wife's kimono. When he opened the door he was greeted by a nice big kiss by the iceman. And the only way he can figure it out was that the iceman's wife had a kimono just like the one he had on.

* * *

She: Oh, John, there was once a time when you used to stroke my chin so lovingly. You don't do it any more.

He: Yes, but that was when you had only one.

* * *

Two men were flying west in a passenger plane, making the first air trips of their lives. The plane touched down at Chicago and a little orange Phillips truck sped out to its side to refuel it. The plane landed again at Wichita and again a little orange truck dashed up to it. The third stop was Denver (you guessed it) little orange truck again.

The first of the two men looked at his watch and turned to his companion.

"This plane," he said, "makes wonderful time."

"Yep," said the other, "and that little orange truck ain't doin' bad either."

* * *

Two Hollywood kids were talking as they walked home from school. "I've got two brothers and one little sister," boasted one. "How many do you have?"

"I don't have any brothers and sisters," answered the second lad, "but I have three papas by my first mama and four mamas by my last papa!"

* * *

Kid Brother: Give me a nickel or I'll tell Dad that you held hands with my sister.

Burt: Here you are.

K. B.: Give me a quarter or I'll tell him you kissed her.

Burt: Here, pest!

K. B.: Now give me five dollars.

* * *

Parson: Goodbye and God bless you. Be careful that the rowdies in town don't play any tricks on you.

Newlyweds: Don't worry, Parson. they won't catch us napping.

BIBLIOGRAPHY — *Classified list of important papers for 1948-1949.*

THE classified bibliography is a special feature of *The Petroleum Engineer* beginning in the Reference Annual of 1947. This included 1946-47 papers on the oil and gas industries and allied industries. It is presented at the suggestion of readers who wish to have an up-to-date compilation of papers and their sources. The bibliography for 1947-48 was published in the Reference Annual 1949 and now begins the 1948-49 bibliography, which will be published in the Continuous Tables.

The list includes papers given before meetings of technical societies, trade organizations, and other groups. What is believed to be the *original source* is given for each item. The name of the organization before which the paper was presented is followed by the place and date of meeting.

The papers are indexed under three classifications to expedite the work of the researcher. They may be found under subjects, under authors, and if presented at a meeting, under organization.

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KEY TO ABBREVIATIONS

AAODC—American Association of Oilwell Drilling Contractors.
AAPG—American Assn. of Petroleum Geologists
ACS—American Chemical Society
AGA—American Gas Association
AIChE—American Institute of Chemical Engineers
AIME—American Institute of Mining and Metallurgical Engineers
Anal. Chem.—Analytical Chemistry (edition of Industrial and Engineering Chemistry)
API—American Petroleum Institute
ASME—American Society of Mechanical Engineers
ASTM—American Society for Testing Materials
Can. J. Research—Canadian Journal of Research
Chem. Inds.—Chemical Industries
Chem. Eng. Progress—Chemical Engineering Progress
IPAA—Independent Petroleum Association of America
Ind. Eng. Chem.—Industrial and Engineering Chemistry magazine.
ISA—Instrument Society of America
J. Am. Chem Soc.—Journal of American Chemical Society
J. Chem. Phys.—Journal of Chemical Physics
J. Inst. Pet.—Journal of the Institute of Petroleum, (London)
J. Org. Chem.—Journal Organic Chemistry
Mid-Continent O&GA—Mid-Continent Oil and Gas Association
NACE—National Association of Corrosion Engineers
NLGI—National Lubricating Grease Institute
NPA—National Petroleum Association
NGAA—Natural Gasoline Association of America
N. Tex. O&GA—North Texas Oil and Gas Association
O&GJ—Oil and Gas Journal
IOCC—Interstate Oil Compact Commission
PEPA—Petroleum Electric Power Association
Pet. Refr.—Petroleum Refiner
Proc. Royal Soc.—Proceedings of Royal Society (London)
Rocky Mt. O&GA—Rocky Mountain Oil and Gas Association
SAE—Society of Automotive Engineers
SGA—Southern Gas Association
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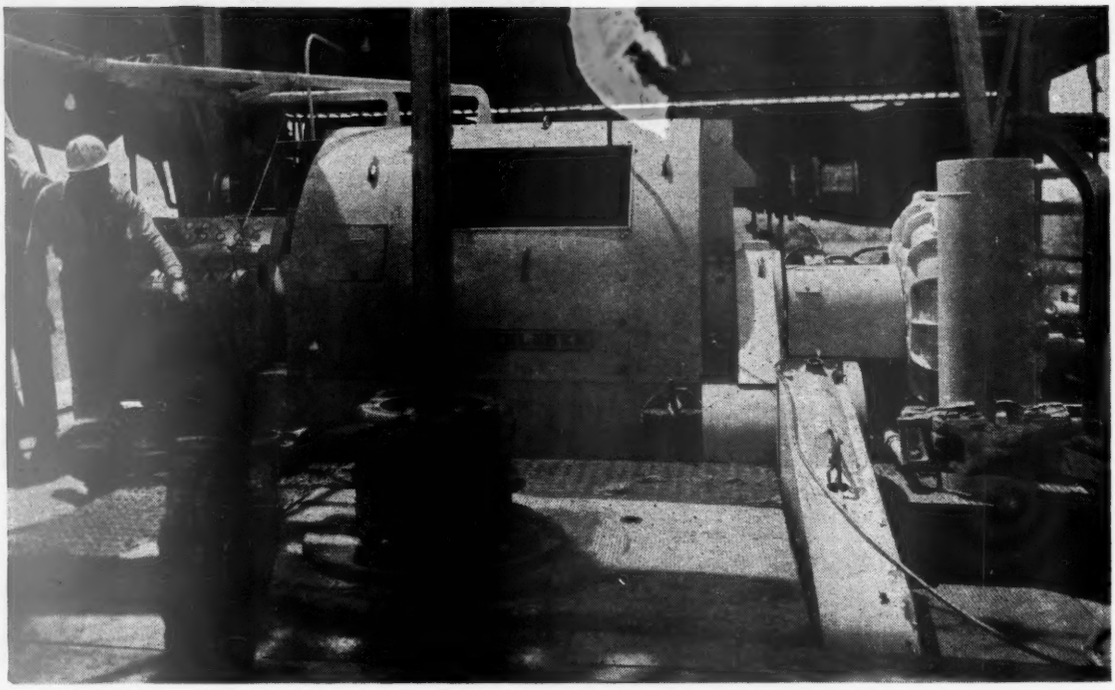

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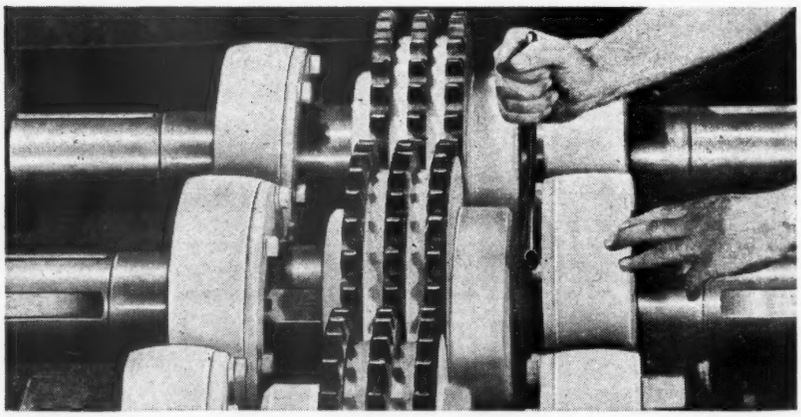

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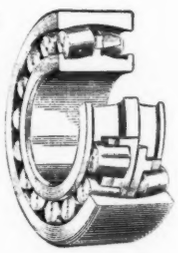

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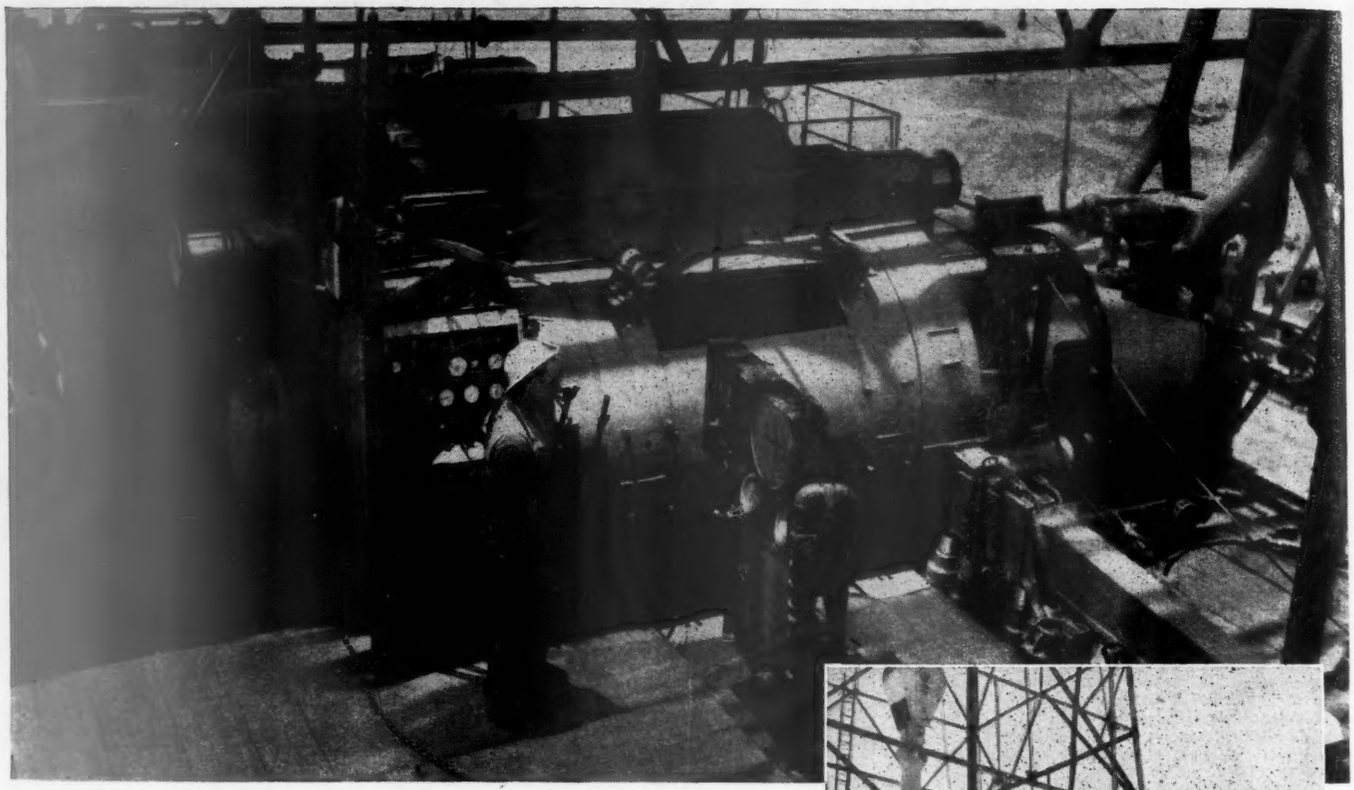

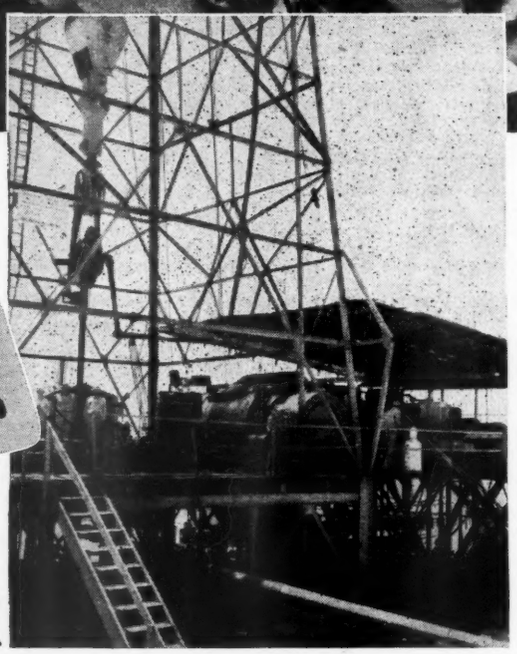

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Why the big increase in drilling speed on this Warren Wright-W. C. Chancellor No. 1 well in Upton County? One big reason—POWER! Waukesha Power!—fast and flexible, with stamina. Shale, limestone and chert all the way down; 73 rock bits used up at 10,024 ft. Responsive power—for faster going in and coming out of the hole. The rig has three Model 6-LRO Waukesha Power Units—six cyl., 8½" x 8½", 2894 cu. in.—each over 400 peak hp. at 1050 rpm., or 300-375 hp. continuously at 900 rpm. on natural gas or butane. Two mud pumps were used, an 8 x 20 and a 7¾ x 18 standby. Rig also has a Brantly hydraulic feed control; and a dynamatic brake.

Helmerich & Payne are using four *Oilwell* No. 96 Rigs and a *Wilson* Giant Rig—all Waukesha powered—a total of eighteen Waukesha 6-LRO Power Units. Bulletin 1079 tells you about the Waukesha Power Line. Send for it.

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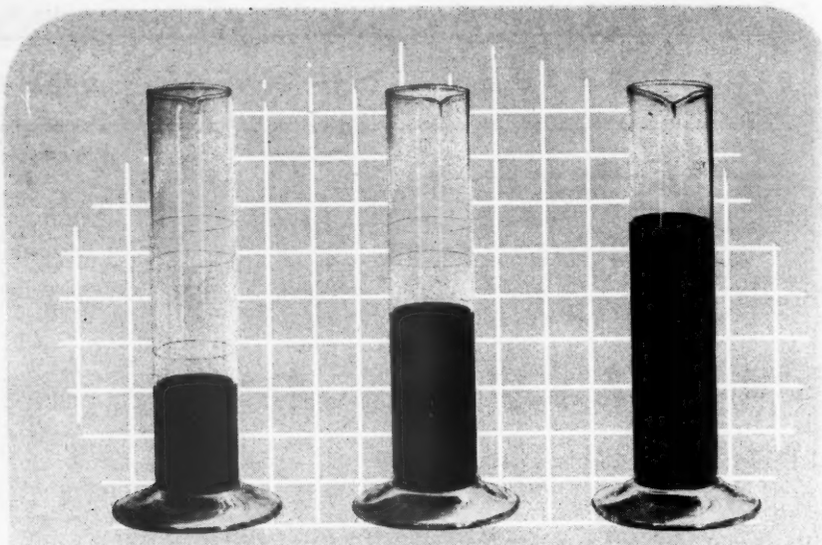

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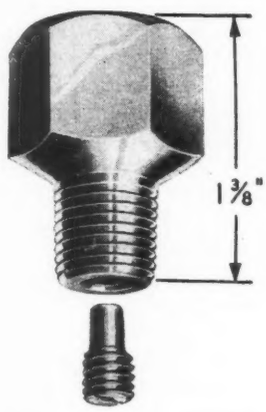
(1) Lubricating System

The Ideal fluid piston rod lubricating system for power slush pumps, originally designed for Ideal E-700 pumps and now standard on C-350 pumps, is now available for Ideal C-250 and C-150 power pumps, and for pumps of other makes, it is announced by The National Supply Company, Box 899A, Toledo, Ohio.

The system consists of a reversible, belt-driven gear pump, 11-gal sump tank with piping, guard and drive sheave for either end of the pinion shaft.

(2) Cartridge Snubber

Helicoid Gage Division of the American Chain and Cable Company, Inc., Bridgeport 2, Connecticut, has



just announced a new stainless steel cartridge snubber.

Made with a cartride of compressed powdered stainless steel and a steel body, it is a simple and effective throttling device for pressure gages to reduce or eliminate pulsations of the gage pointer. No adjustments are needed. Specific porosity of cartridge makes it effective for required service —air, gas, water, steam or oil. Available for all pressures up to 10,000 lb.

(3) Fuel Vaporizer

To provide fuel for gas engines in regions where natural gas has become scarce or expensive, Black, Sivalls and Bryson, Inc., 20 Delaware, Kansas City 6, Missouri, announces a simplified and compact unit to vaporize crude oil. It is a fuel vaporizer that generates fuel gas from crude oil for use in gas engines. The fuel vaporizer, which is actually a miniature topping plant, is designed to fuel pipe line pumping engines and gas engine equipment on lease pumping jobs where gas is failing.

The BS&B fuel vaporizer is a "package" unit equipped with all necessary controls. It is insulated to prevent heat loss from the exhaust gas heater and the flash separator. BS&B fuel vaporizers are built in four standard sizes of 20, 40, 110 and 300 hp.

(4) Weighting Material

A new weighting material for drilling muds has now been made available by Oil Base, Inc., 130 Oris Street, Compton, California. OB Hevywate is pure ground barytes, imported from Mexico. The color is white and it assays between 4.26 and 4.41 specific gravity, which leaves practically no room for the presence of foreign matter, states the manufacturer.

OB Hevywate is ground at the Compton plant, 99 per cent through 325 mesh. It is packed 100 lb net.

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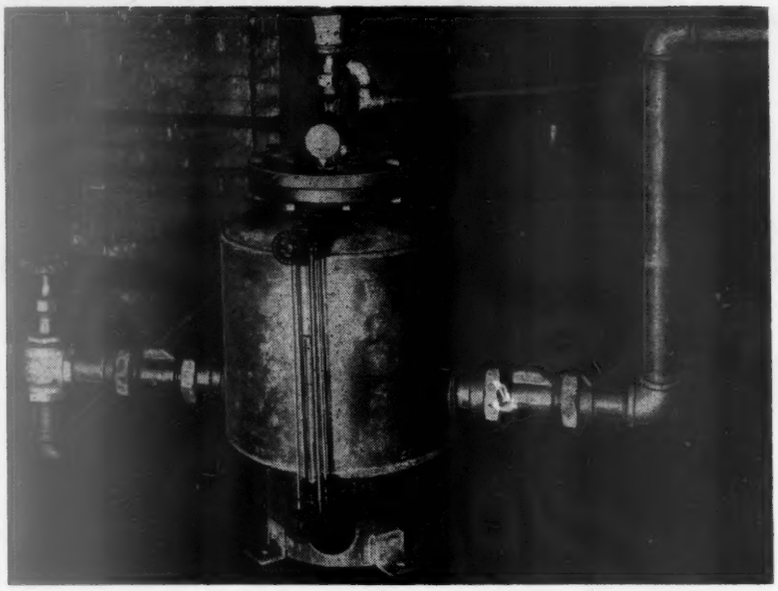

(5) Jet Pump

A two-part cycle, which is automatically continued until the pump is turned off, enables the Penberthy cycling jet pump to lift by suction and discharge against heads approximately equal to the gas, air or steam pressure used.

This pump consists of a receiver tank, float-controlled operating valve, ejector and necessary piping, gauges and valves. Gas, steam or air under pressure is used for operation. Other than the float-controlled operating valve and two check valves there are no moving parts. Two-inch size is available from stock and is readily modified to suit conditions.

For further information write to the Penberthy Injector Company, 1242 Holden Avenue, Detroit 2, Michigan.

(6) Control Valve

A new development in the design of air-operated control valves has been announced by The Foxboro Company, Foxboro, Massachusetts.

The quick and easy reversibility feature of the new stabilflo valve means valuable time-saving where changes must be made in existing installations, great convenience in test work or pilot plant operation, and simplification and reduction in the stock of spare valves.

The new reversible motor with its forged steel motor housing is similar in general appearance to the conventional stabiflo valve.

(7) Shaft Seal

For installation on equipment, moving or transferring liquids, which requires a positive shaft seal, as well as for replacement of conventional stuffing boxes where packing has proved unsatisfactory, the Peerless Pump Division, Food Machinery and Chemical Corporation, has developed a new mechanical shaft seal to provide a mechanical means for prevention of leaks around a rotating shaft.

These seals are available in three general classifications, standard, abrasive-resistant, and special.

The complete mechanical shaft seal is of Peerless' own design and manufacture and is of the cartidge type.

The maximum pressure recommended for these seals is 400 psi. Liquid temperature handled can be up to 250 F with no water cooling; with water cooled stuffing boxes, liquid temperatures up to 300 F can be handled. Seals can be furnished for application to rotating shafts ½ in. to 3 in. diam.

Further detailed information may be obtained by writing the manufacturer, Peerless Pump Division, Food Machinery and Chemical Corporation, 301 West Avenue 26, Los Angeles 31, California.

(8) Pipe Wrenches

Williams aluminum pipe wrenches are fully drop-forged from special high tensile aluminum alloy carefully heat-treated for maximum strength and toughness, states J. H. Williams and Company, Buffalo 7, New York.

The aluminum pipe wrenches have natural satin finish. Replaceable alloy steel jaw inserts are interchangeable. The same insert fits handle or movable jaw. Multiple dove-tail design and retaining screw assure easy assembly and firm anchorage. Inserts are cadmium-plated. Steel adjusting nut is case-hardened, knurled for easy adjustment and cadmium-plated. Movable jaw is suspended between two springs of unique design.

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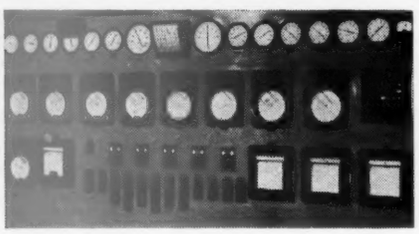

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(9) Pumping Jack

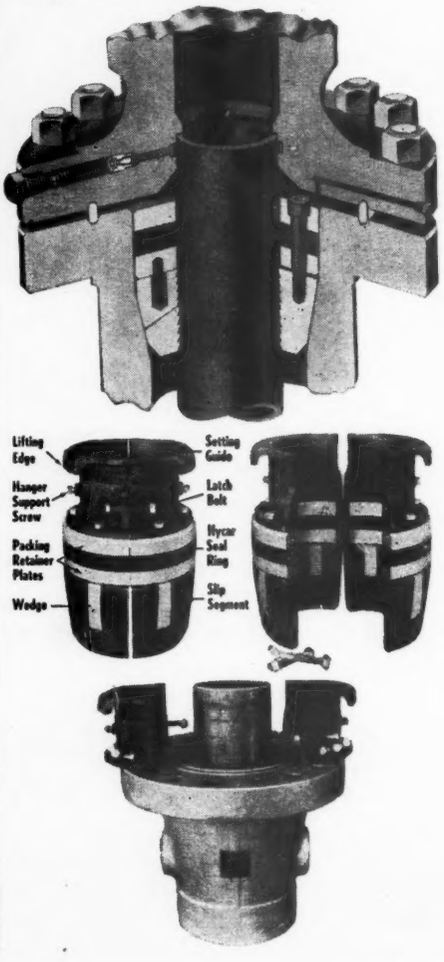
Pelton Water Wheel Company announces the addition to the Series A and A-P long stroke hydraulic pumping jacks, of a new heavy duty series, designated C-P. The new series was designed to provide the largest and most universal surface pumping equipment.

It is available in polished rod load ratings to 40,000 lb; load range ratings to 27,000 lb; stroke lengths to 30 ft; and with polished rod travel to 350 ft per min.

(10) Casing Hanger

Cameron Iron Works, Inc., Houston, Texas, has announced a new automatic-seal, wrap-around, casing hanger, designated as type "A." According to the manufacturer, the new hanger offers a number of advantages. The type "A" hanger when ready for assembly consists of six slip segments, attached to the two halves of a hinged packing assembly, with a setting guide.

The hanger assembly alone, is suitable for most intermediate and production strings where no pressure cross-over is required, according to the manufacturer. However, if restricted area pressure cross-over is required, Cameron tubing heads or spools may be had with a sealing arrangement in the lower flange.



(11) Bruning Whiteprinter

A new model has been added to the line of Bruning Whiteprinters. It is known as the "Model 50." It provides a way to make reproductions of anything drawn, typed, printed, or written, states the manufacturer. It is designed for users who need a compact Whiteprinter capable of producing up to 10,000 sq ft of BW prints during an ordinary working day.

The Model 50 operates at variable speeds up to 24 fpm. Prints are delivered flat and dry, ready for instant use, neatly stacked in a convenient receiving tray on the front of the machine.

Further information on the Model 50 and the BW process is offered to interested readers by simply writing to the Charles Bruning Company, 4754 Montrose Avenue, Chicago 41, Illinois.

(12) Snow Plow

Snow plow attachments, both "V" and reversible blade types, are now available for the big four wheel drive, 1½ cu yd, Hough Model HM payloader.

Features of this big machine that make it effective for snow plowing are 75 hp gasoline or diesel power driving all four wheels; large pneumatic earthmover tires; hydraulic power control of raising and lowering of the plow; four speeds in each direction up to 24 mph; separate forward-reverse shift; power-boosted rear wheel steering; powerful hydraulic brakes; utmost operator visibility; all-weather cab available.

Information on this payloader and its snow plow attachments can be secured by writing The Frank G. Hough Company, 864 Sunnyside Avenue, Libertyville, Illinois.

(13) Pumping Unit

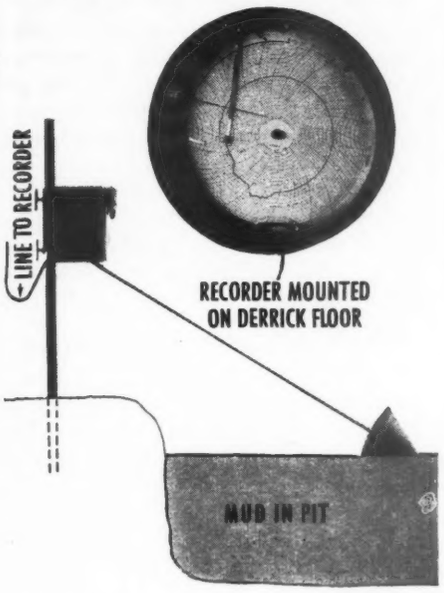
Recently announced by Cabot Shops, Inc., Pampa, Texas, is a new small pumping unit featuring stroke length up to 20 in. The designation T2LU-1.55C has been given this series of units.

Brief specifications are as follows: API beam rating, 2430 lb; length of strokes, 12 in., 16 in., and 20 in.; API peak torque at 20 spm, 7650 in. lb; API nominal hp at 20 spm, 1.55; reducer—single reduction, 1.5SC; ratio, 10.875 to 1; standard sheave, 15.6 pd 2A/B.

An important advantage of this new Cabot unit is that it will accommodate either a slow speed internal combustion engine or an electric motor, states Cabot. This flexibility gives producers an opportunity to choose the optimum power for their operating conditions.

(14) Indicator-Alarm

Petroleum Instrument Company, Houston, Texas, has announced a new instrument for measuring and record-



ing the level of a mud pit. Designated as the automatic pit level indicator and alarm system, the instrument warns the driller instantly of changes, either upward or downward, in the level of the fluid in the pit. Should the well begin to unload, the level of the fluid in the pit would rise and cause the instrument to sound the alarm. Conversely, should the formations begin taking an abnormal quantity of drilling fluid, which would diminish the mud returns and cause the level of the pit to lower, the alarm would also sound.

According to the manufacturer, the instrument will measure 1 in. variations in the pit level and the alarm system can be set to ring the electric bell when the pit level rises or falls any predetermined measure.

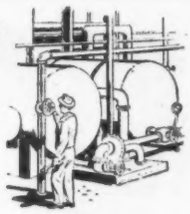
(15) Semi-Selective Guns

Lane-Wells Company, Los Angeles, California, announces the introduction of semi-selective guns for its Koneshot perforating service. The new 48-shot, F-2 guns, are now available at most of the company's 50 operation locations.

The new equipment consists of two guns connected by a special sub which makes it possible to fire each gun separately. This combination enables the operator to fire up to 48 shots on a single run in the well, with one-half of the shots in one zone and one-half in another zone.

Although two-twenty-four shot guns are usually used with the F-2 equipment, guns with a smaller number of shots may be used where only a limited number of perforations are desired.

Positive control of L. P. Gas...



LUNKENHEIMER VALVES

400 lb. W. O. G. Bronze valves

FOR Liquefied Petroleum Gases ... LP-Gas systems bulk transfer- and storage tanks, domestic cylinder charging manifolds, vapor differential compressor and the many industrial uses . . . Lunkenheimer 400 lb. W.O.G. (Water-Oil-Gas) Valves meet every need.

Designed for this particular service and reflecting Lunkenheimer Quality throughout, these rugged valves have special packing and a special, easily renewable non-metallic disc. They seat tight and stay tight.

Approved by Underwriters' Laboratories, Inc., for Liquefied Petroleum Gases.

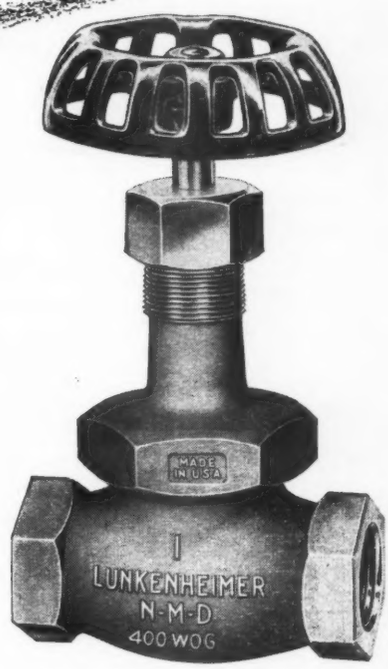


Fig. 400 Bronze Globe Valve ¼ in. to 3 in.
Fig. 401 Bronze Angle Valve ¼ in. to 3 in.

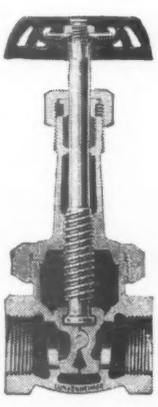


Fig. 404 Bronze Union Bonnet Gate Valve ¼ in. to 3 in.

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LUNKENHEIMER DISTRIBUTORS are located in all oil producing and refining centers. Write for Bulletin 576, or ask your distributor for a demonstration of Lunkenheimer Valves for Liquefied Petroleum Gases.

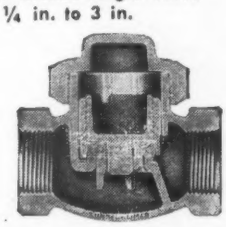


Fig. 402 Bronze Lift Check ¼ in. to. 2 in.

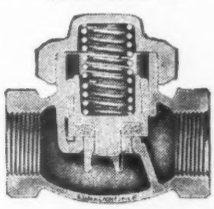
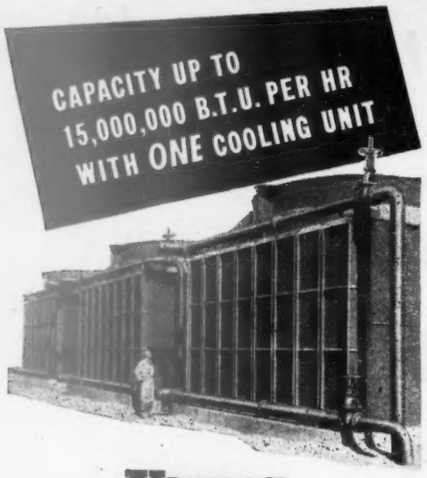


Fig. 403 Bronze Lift Check with Spring ½ in. to 2 in.

LUNKENHEIMER VALVES



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- Simplified manifolding and factory subassemblies cut erection time and costs.
- Low-level mounting permits ready accessibility for inspection and maintenance.
- Independent fan and drive mounting eliminates vibration.
- Available with round tube cores for pressure operation or flat tubes for extreme cooling efficiency.

There's a VAD model capable of dissipating from 3,000,000 to 15,000,000 BTU per hr, and for cooling water, oil, gas and condensing steam and vapor, *in any combination of services!* A multiple installation of these units will handle *any* cooling problem. Such versatility and reserve cooling capacity has earned an enviable reputation for the VAD, designed and manufactured by Young, specialists for more than two decades in the development of oil field and industrial cooling and condensing equipment. Write for Catalog 448.

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(16) Wide-Face Casing Tong

The new BJ wide-face casing tong was engineered and designed with the safety of the casing and casing crew in mind, states the manufacturer. It is light in weight and is made in individual sizes to handle 4½ in. to 11¾ in. casing and couplings. Flattening, crimping and bottle-necking of thin-wall casings are eliminated due to the wider face and true bore, says the Byron Jackson Company, 756 South Broadway, Los Angeles 14, Calif.

(17) Swivel Design

Nearly double operating capacity, 300 tons at 100 rpm, without added weight is claimed for a revolutionary new swivel design by International Derrick & Equipment Company, P. O. Box 1331, Dallas 1, Texas. The tandem arrangement distributes the operating load equally over a dual main bearing. The swivel body design forces oil to be circulated through the bearings when the swivel is rotated. The DSS-300 uses the Ideco full floating wash-pipe assembly.

(18) Switch Box

A new explosion proof switch box, designed to accommodate mercury tubes to make and break electrical circuits, is now being manufactured by Shand and Jurs Company, Berkeley, California. Designated by S&J as Fig. ST-5500, this switch is listed for use in hazardous locations, in ambient temperatures up to 155 F.

Body and cover of the switch are of cast aluminum. The body is provided with sturdy mounting flanges, and measures approximately 9½ in. long by 5¼ in. deep. It is provided with a threaded hub to accommodate a stainless steel operating shaft on which are mounted the two mercury tube electrodes. A ½-in. threaded outlet is also provided for conduit connection. This explosion proof switch is ideally suited to turn on lights, sound horns, or set off an alarm from a distance.

(19) Bronze Gate Valves

A new line of 200-lb union bonnet bronze gate valves is being introduced by The Ohio Injector Company, Wadsworth, Ohio.

This new series carries a rated working pressure of 200 lb steam at 550 F and 400 lb water, oil, and gas non-shock, states the manufacturer. These valves are of the union bonnet screwed end type and are available in the solid wedge rising stem, Fig. 7200, double-disc rising stem, Fig. 7202, or solid wedge non-rising steam design, Fig. 7208, all having tapered seats and wedges.

(20) Portable Air Compressor

A new 500-cfm Mobil-Air for portable compressors, has been announced by the Ingersoll-Rand Company. The engine is the well-known International-Harvester heavy-duty UD-24 which starts easily as a low-compression gasoline-engine and after a short warmup period is shifted to full diesel operation by means of a single lever, states the manufacturer.

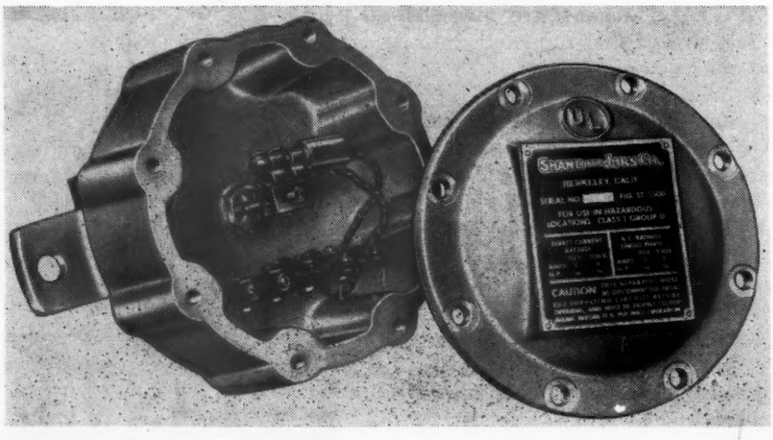
This portable, known as the IKA-500, has all the features used on Ingersoll-Rand's KA-Series Mobil-Air compressors in sizes from 105 to 500-cfm. Full 500-cfm capacity is delivered at rated 100 psi pressure.

For additional information, write Ingersoll-Rand Company, 11 Broadway, New York 4, New York.

(21) Diesel Engine

Two new six-cylinder, highspeed diesel engine models designed for on-highway and off-highway automotive applications have been placed in production by the Cummins Engine Company, Inc., Columbus, Indiana. Both the HRBB-600 (highway) and HRBBI-600 (off-highway) models have a maximum rating of 175 hp at 2000 rpm. Both the HRBB-600 and HRBBI-600 Cummins diesels have a piston displacement of 743 cu in., a 5⅛-in. bore, and 6-in. stroke.

New explosion-proof switchbox.



trade literature

PUBLICATIONS LISTED ARE SENT FREE UPON REQUEST

(22) Complete Line of Equipment

Patterson-Ballagh, manufacturers of oil field specialties, has announced the availability of a 52-page catalog covering its complete line of equipment. The catalog includes protectors and stabilizers for drill pipe, wire line guides, wipers, both drill pipe and Kelly, bumpers for travel block, links, swivel, and crown. A complete description of mud guns and production items rounds out the Patterson-Ballagh catalog. Catalogs are available through P-B field representatives, or Houston office, 6247 Navigation Boulevard, or home office. 1900 East 65th Street, Los Angeles 1, California.

(23) Mud and Chemicals

A new 8-page catalog has been released by Oil Base, Inc., describing all of their present products.

The catalog gives complete information on black magic, white magic (new oil emulsion mud), chemicals, weighting materials, OB mud guns, OB hand cleaner, and several new mud conditioning products. Copies may be obtained by requesting them from any Oil Base, Inc., branch office or by writing to the main office and plant at 130 Oris Street, Compton, California.

(24) Data Sheets

The W. C. Hardesty Company, Inc., 41 East 42nd Street, New York 17, New York, has available a set of data sheets, which sets forth in easy-to-read chart form the specifications and respective solubility in oils, solvents and waxes of various molecular weight polyethylene glycol mono and di stearates, laurates and oleates, and also various glycerol and glycol esters of fatty acids. This information and samples are obtainable upon request.

(25) Air Compressor Unit

A bulletin with complete information on the Byron Jackson Company, Los Angeles, California, air compressor unit is available. Designed especially for use with the BJ Powairmatic tubing tong, it is available in both trailer mounted models and skid mounted.

Specifications, pictures of the air compressor units and other data on the BJ trailer are contained in the bulletin.

(26) Bronze Gate Valve

A full and informative description of the Fig. 27 and Fig. 30 line of Standard bronze gate valves is available in the new Circular 102, published by The Kennedy Valve Manufacturing Company, Elmira, New York.

Design features of the two valves are explained in detail with a large sectional drawing of a valve providing easy visual reference. Service ratings and a comprehensive table of sizes and dimensions are included.

(27) Oil Testing Instruments

A revised 12-page catalog, "Tag Oil Testing Instruments for Petroleum Products," has been published by the C. J. Tagliabue Corporation (New Jersey), 614 Frelinghuysen Avenue, Newark 5, New Jersey. Printed in color, the catalog contains illustrations and specifications of the complete line of Tag, Tag-Saybolt, and the Tag-A.S.T.M. instruments for principal laboratory tests of petroleum. The catalog, number 699H, is available from the Tagliabue Company.

(28) Couplings, Fittings, and Valves

The 1950 catalog of Unibolt couplings, fittings and valves for drilling, producing, and pipelining has just been made available by Thornhill-Craver Company, Inc., Houston, Texas. Printed in three colors, the 28-page booklet is fully illustrated and includes numerous specification charts and drawings.

The Unibolt products described include steel couplings, slush pump suction strainers, scraper traps, self-sealing oil resistant gasket, pipe line couplings, pipe line strainers, malleable couplings, tees and crosses, flexi-ball joints, Christmas tree fittings and flow beans.

Address all requests for copies of this catalog to Thornhill-Craver Company, Inc., Unibolt Division, 1111 Lockwood Drive, Houston, Texas.

(29) Beam Pumping Units

National beam counterweighted pumping units for light to medium loads are presented in a new 16-page, three-color illustrated bulletin issued by The National Supply Company, Box 899A, Toledo, Ohio.

Bulletin 335 covers six basic pumping units having API walking beam ratings from 3200 to 11,000 lb. It stresses construction and design features, classifying them by the main structural elements. Precision parts such as saddle bearings, wrist pins and pitman bearings are further illustrated by exploded views of parts.

(30) Cleaning Materials and Methods

Improved cleaning materials and methods for all divisions of the petroleum industry are reviewed in a 32-page booklet recently published by Oakite Products, Inc., New York, New York.

The booklet describes specific materials and methods which have demonstrated pronounced effectiveness and economy in performing important maintenance operations in the petroleum industry, states the manufacturer.

Industry personnel and other readers desiring copies of this new Oakite cleaning booklet may obtain them by addressing Oakite Products, Inc., 148 Thames Street, New York 6, New York.

(31) Smoke Indicator

The Trimount Instrument Company has issued a new circular on their McNeil smoke indicator. Designed for boiler room service, it is a heavy duty unit with an easy-to-read density meter, an oversize light beam, and flush panel construction. The four-inch lens is readily removed for cleaning and the recorder can be added at any time. The unit is designed for use with steam jets or over the fire blower.

For your copy of this circular write to the Trimount Instrument Company, 37 West Van Buren Street, Chicago 5, Illinois.

(32) Chemical Products

A new catalog issued recently by Black, Sivalls and Bryson, Inc. is "Products for the Chemical Industry." The 20-page booklet describes twelve different products of interest to the chemical industry. It points up special fabrication of steel products that BS&B has been designing for over half a century. It also includes descriptions of gas dehydrators, tubular heaters, indirect heaters, chemical feeders, gas scrubbers, wood and steel tanks, walkways and stairways, loading racks, safety heads, vent valves and vent valve-flame arrestor combinations.

The catalog is illustrated with more than thirty photographs and drawings. Charts give capacities, ratings and specifications. Black, Sivalls and Bryson, Inc., 720 Delaware, Kansas City 6, Missouri.

(33) Fire Extinguisher

A new 20-page fire extinguisher catalog has been brought out by Ansul Chemical Company, Marinette, Wisconsin.

The new catalog illustrates the complete Ansul line. Included are improved Ansul Model B extinguishers, piped systems, large stationary units, fire trucks, trailers, etc. The catalog also features charts showing characteristics of approved hand fire equipment and comparative effectiveness graphs.

(34) Pressure Vessel Accessories

Complete engineering data and specification details on Lenape pressure vessel accessories are included in the new 64-page Catalog 9-49 now available from Lenape Hydraulic Pressing and Forging Company, P. O. Box 161, West Chester, Pennsylvania.

Sectionalized for easy reference, the company's line of welding necks, manways, nozzles, covers, rings, studding outlets, saddles, fittings, and other press formed specialties is factually presented with complete dimensional data, pressure ratings, code specifications, construction details, and service recommendations.

(35) Cable Load Limit Switch

The Martin-Decker cable load limit switch is an instrument for operating an electric switch when the cable tension reaches a predetermined value. It may be applied to any wire cable from 1/4 in. to 3/4 in. in diameter without cutting or removing the cable.

An alloy steel heat-treated rectangular beam is clamped on the cable, and an offset is placed in the cable which deflects the beam so that the loading will operate the switch. In order to set the switch at any predetermined load, an adjusting screw is provided; and also, an auxiliary stud is provided for sealing the switch when used as a limiting device by safety departments or crane engineers.

(36) Diamond Core Bit and Barrel

Core Laboratories, Inc., has published a four-page folder containing descriptions of the techniques used in the manufacture of Spiral-Set diamond core bits, and a comprehensive cut-away illustration of the new Core Lab diamond core barrel. Write Core Laboratories, Inc., Box 5810, Dallas, Texas.

(37) Combustion Chambers and Burner Nozzles

A booklet describing and illustrating equipment for the production of hydrogen chloride gas by burning hydrogen and chlorine has been issued by National Carbon Company, Inc., 30 East 42nd Street, New York 17, New York.

The booklet, Catalog Section M-9602, describes the graphite combustion chamber and the impervious graphite burner nozzle, outlines the operation of the complete system, and points out the principle features of these products. Capacities of the combustion chambers and sizes of the burner nozzles are listed in a convenient table, followed by assembly drawings of the equipment.

(38) Services and Products

Spartan Tool and Service Company, Houston, Texas, has announced the publication and immediate availability of its new 1950 catalog which gives a complete description of the firm's services and products. It is offered as Spartan's first complete catalog.

Photos of Spartan's cementing trucks and equipment demonstrate the size and type of service available. Complete description is given of Spartan's motor-driven cementing units, the high-pressure, the "PL" and the medium-pressure unit, as well as Spartan's steam unit. With the discussion of each unit, volumns and pressures are offered in easily-read graph form.

Copies of this catalog may be had from Spartan Tool and Service Company, 2101 Old Spanish Trail, Houston, Texas.

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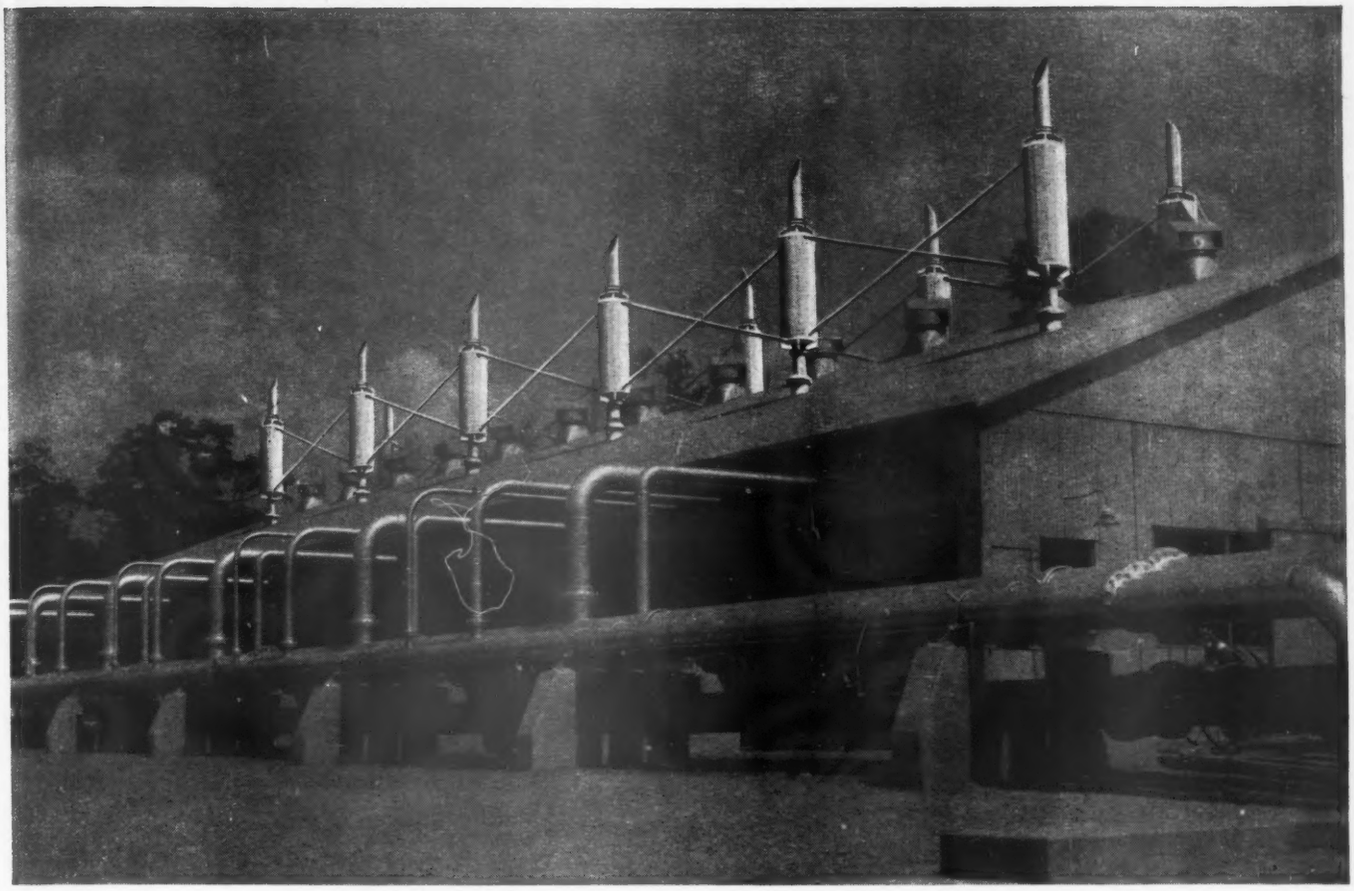
HOTEL GALVEZ	Galveston
HOTEL JEAN LAFITTE	Galveston
CORONADO COURTS	Galveston
JACK TAR COURT HOTEL	Galveston
MIRAMAR COURT	Galveston
HOTEL CAVALIER	Galveston
HOTEL PLAZA	Laredo
HOTEL LUBBOCK	Lubbock
HOTEL FALLS	Marlin
HOTEL CACTUS	San Angelo
HOTEL MENGER	San Antonio
ANGELES COURTS	San Antonio
VIRGINIA	
HOTEL MOUNTAIN LAKE	Mountain Lake
HOTEL MONTICELLO	Norfolk



Burgess-Manning Snubbers on twelve 300-hp engines of the Warren Petroleum Corporation plant of Crossville, Illinois.

Snub the Slug—and Stop the Noise

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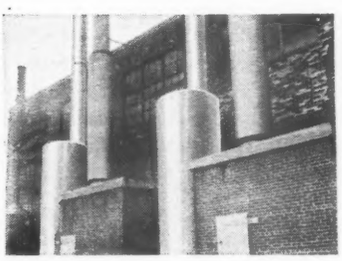
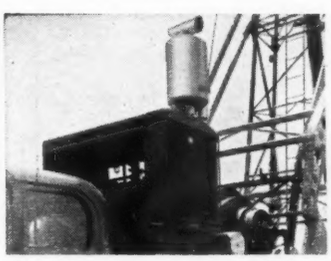
Burgess-Manning Snubbers prevent noise by dissipating the "slugs" of gas from engine exhausts . . . with no interference to high engine performance. Special "Fog-jet" Snubbers snub the "slugs" to prevent exhaust noise, scrub out glowing sparks, spray a mist of cooling water vapor on the exhaust gases entering the Snubber . . . to cool and extinguish flame from the engine.

Burgess-Manning Snubbers are designed for Diesel, gas, dual fuel, and gasoline engines used in stationary, marine, locomotive, and portable service. A wide variety of types and sizes of Snubbers are available.

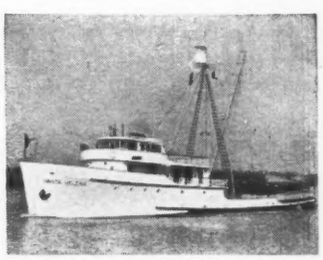
If you are considering the installation of Diesel or other type internal combustion engines, or if you have existing mechanical problems in exhaust systems, or noise complaints, let Burgess-Manning submit Snubber recommendations. Long experience guarantees satisfaction. Write for literature.



South Norwalk Electric Plant is equipped with Burgess-Manning Standard Industrial Exhaust Snubbers.



Oil-well servicing truck fitted with a Burgess-Manning Spark Arrester-Snubber.



Tuna purse seiner, "Santa Helena," uses Burgess-Manning SDM Marine Spark Arrester-Snubbers.

BURGESS-MANNING COMPANY

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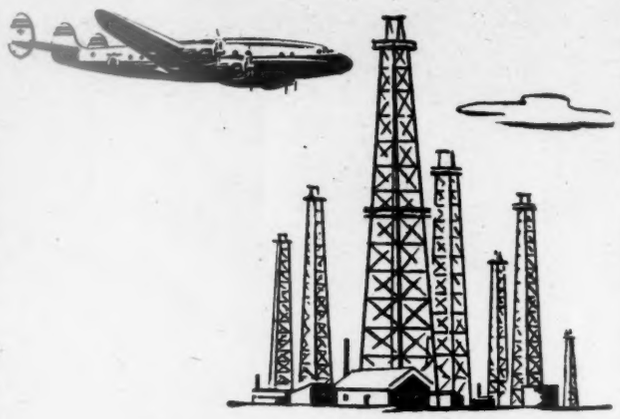

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FOR INFORMATION SEE YOUR TRAVEL AGENT or KLM Royal Dutch Airlines, 572 Fifth Ave., New York, N. Y., LU 2-4000; 308 N.E. 1st Street, Miami, 3-8455. Other KLM offices in Los Angeles, San Francisco, Chicago, Washington, Boston and Montreal.

▸ **Turkey, An Economic Appraisal,** *by Max Weston Thornburg, Graham Spry, and George Soule. The Twentieth Century Fund, New York City, New York. Pages, 324. Price, $3.50.*

This economic appraisal of modern Turkey presents facts that American businessmen and persons concerned with government policy need to know. According to the authors, Turkey is a land of great resources, but a burdensome taxation system and the policy of state control are formidable obstacles to effective aid from the outside. Specific and constructive suggestions are made, however, looking toward the application of American know-how and capital in the development of a free and strong Turkish economy.

▸ **Refractories,** *published by the General Refractories Company, Philadelphia, Pennsylvania. Pages, 272. Price, $5.*

This recently published book supplies the refractories field with a handbook of complete, accurate and up-to-date information. It begins with a brief history of refractories from the sun-dried brick of old Egypt to the modern all-basic open hearth steel furnace, including a history of the General Refractories Company. One section of the book lists, pictures, and gives dimensions of all standard refractory brick sizes and shapes.

▸ **Petroleum-Engineering Study of Atlanta Oil Field, Columbia County, Arkansas,** *by C. H. Riggs, Department of Interior, and Bureau of Mines. Obtained from Bureau of Mines, Publications Distribution Section, 4800 Forbes St., Pittsburgh, Pennsylvania. Pages, 55.*

This booklet is the product of work done under a cooperative agreement between the Bureau of Mines, United States Department of the Interior, and the Arkansas Oil and Gas Commission. Reservoir conditions and oil production history of the Atlanta field in Columbia County, Arkansas are described along with other development practices. The eastern part of the Atlanta field, considered one of the important Smackover limestone fields in southern Arkansas, was discovered in 1938.

▸ **Clay Deposits of the Cisco Group of North-Central Texas,** *by F. B. Plummer, H. B. Bradley, and F. K. Pence, University of Texas, Austin, Texas. Pages, 44. Price, $1.*

The Bureau of Economic Geology and the Research Laboratory in Ceramics, Texas University, have published this cooperative report giving cross sections of certain commercially important clays in north-central Texas. Also included in this issue are maps showing extent of outcrop and principal exposures of Quinn, Curry, and Craddock clays in Brown, Eastland, Stephens, and Young counties.

▸ **Consulting Services,** *Association of Consulting Chemists and Chemical Engineers Inc., 50 East 41st Street, New York 17, New York; Twelfth Edition, 1949. Pages, 132.*

This new edition, formerly named "Classified Directory," includes the names, addresses, and specialties of all affiliated members of the association. It is divided into three sections, the Key Sheet, as aid to finding the desired reference or name; Scope Pages, which describe in turn the qualifications and specialties of each member firm or individual; and the Index, which lists members alphabetically and by geographical location, the latter a new feature of the edition.

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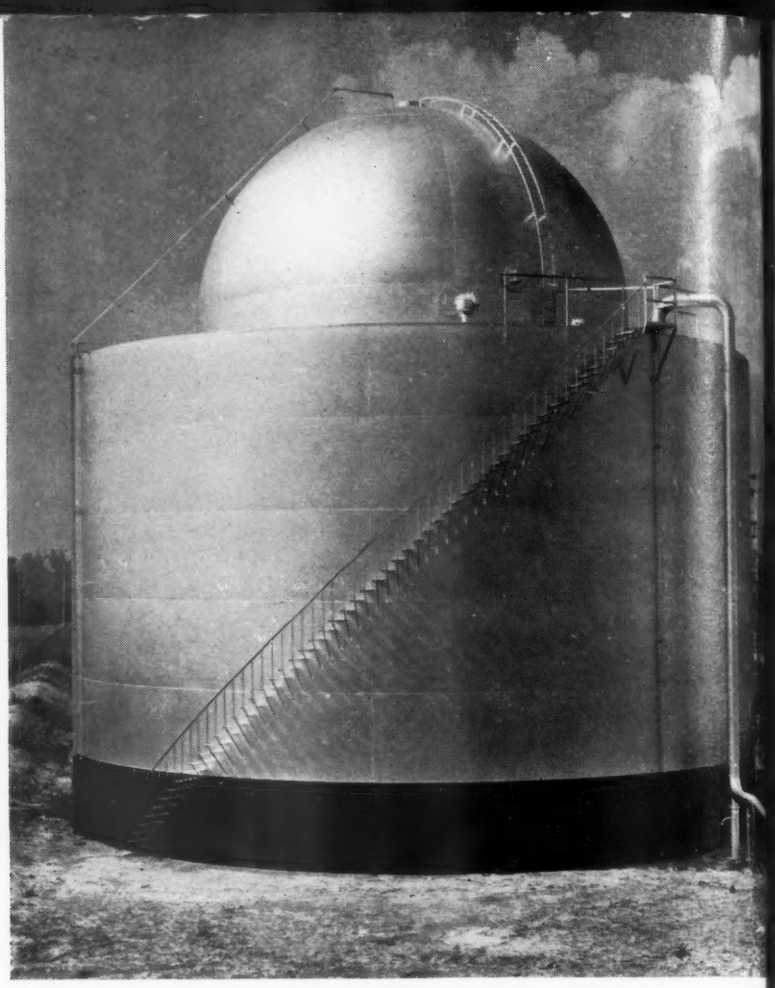
DECEMBER 1949

The HORTON Vapordome ROOF

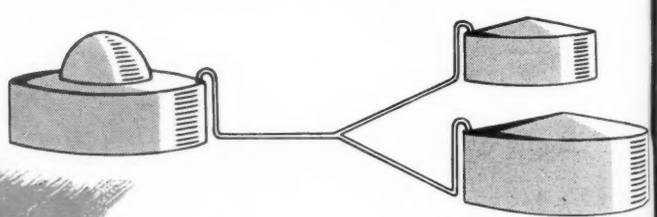
gives you 2 methods to stop evaporation losses caused by breathing in oil storage tanks

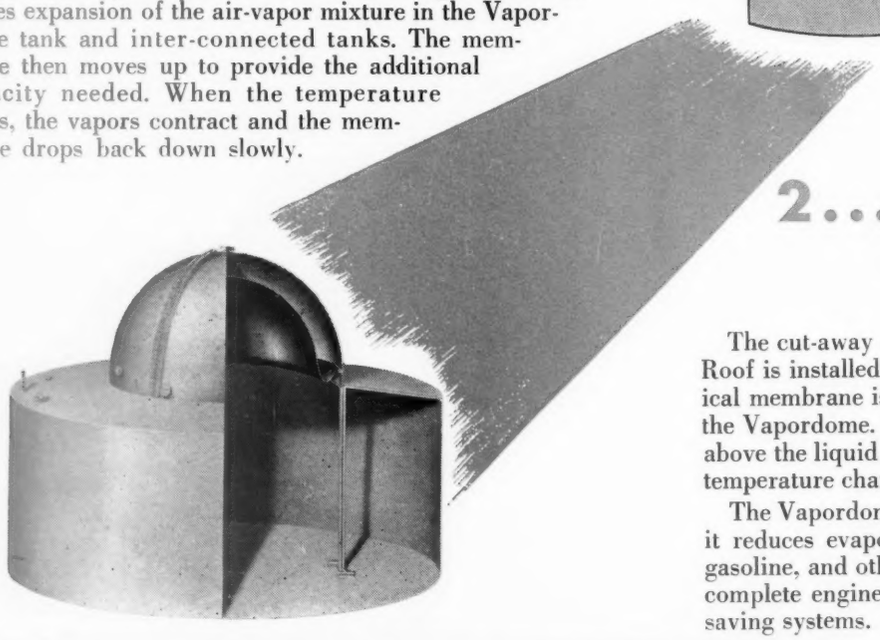


RIGHT: *60-ft. diam. by 40-ft. tank equipped with a 38-ft. diam. Vapordome Roof at the Continental Oil Company's marketing terminal at Galena Park, Texas. The vapor line connecting the Vapordome Roof to the vapor spaces of four 10,000-bbl. tanks is shown at the right.*

1...as the central unit of a vapor-saving system

With this method, the vapor spaces of adjacent cone-roof tanks are connected by large-diameter vapor piping to the tank having a Vapordome Roof. This roof contains a flexible hemispherical membrane. Increasing temperature causes expansion of the air-vapor mixture in the Vapordome tank and inter-connected tanks. The membrane then moves up to provide the additional capacity needed. When the temperature drops, the vapors contract and the membrane drops back down slowly.





2...as the roof of a single tank

The cut-away diagram at the left shows how a Vapordome Roof is installed on a flat-bottom tank. A flexible hemispherical membrane is attached by its outer edge to the equator of the Vapordome. This membrane allows the air-vapor mixture above the liquid in the tank to expand and contract, when the temperature changes, without being vented and lost.

The Vapordome Roof pays for itself in a short time because it reduces evaporation losses from tanks storing crude oil, gasoline, and other hydrocarbons. Write our nearest office for complete engineering data on Vapordome Roofs and vapor-saving systems.

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